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HOUSE-TO-HOUSE ELECTRIC LIGHTING.

IN our other columns we publish a sufficiently long description of the proposed B.T.K. system of electric lighting at Colchester to enable our readers to form a very fair idea as to the probable results which may be looked for when that important installation is completed and in actual working condition. So far as past experience guides us we must confess to a feeling of grave doubt as to the ultimate success of any installation in which lead plate accumulators form the largest item in the total plant. No matter what may be said to the contrary, and notwithstanding the fact that some enthusiastic gentlemen who have accumulators fitted up in their private houses speak in most favourable terms of their action, it is well understood that the good practical results which were confidently expected from the employment of secondary batteries have not been borne out, and we do not anticipate that the B.T.K. accumulators will show up more favourably than those which are better known. Indeed the electrician in charge of the Colchester electric lighting station could not give any definite opinion on the lasting capabilities of the company's accumulators when a question was asked upon that point. It is said in some quarters that the accidental extinction of the light is guarded against by the employment of accumulators, but this is not the fact, for the continuity of the current depends upon several things combined, and not one alone. If a breakdown should occur in the main charging wires the accumulators could not, until repairs had been effected, be charged, and if an accident happened to any of the service wires, the stored electrical energy in that particular portion of the district could not, for the time being, be utilised. In fact it is possible for a breakdown to happen to either the engine, dynamos, accumulators, or conductors, and it follows that the more complication introduced into any system of electric lighting the greater become the chances of failure. The rocking switches and the apparatus attached to each master cell necessarily complicate matters, and these would, doubtless, demand a considerable amount of skilled attention. We are also under the impression that more trouble than, as yet, has been anticipated will be experienced through the method adopted of placing the conductors underground.

If we are not mistaken the insulated wires are placed in the brick trenching without any further protection, and even if loss of insulation occurs through nothing else, it need scarcely be said that rats and such vermin are not averse to gnawing off the insulation covering of wires when more enticing provender is unprovided.

It is to be hoped, however, that the precaution taken may be found sufficient, that the minor apparatus connected with the plant will work satisfactorily, and that the secondary batteries will be found free from such drawbacks as have hitherto obtained in almost all types where lead plates form the electrodes. Should the installation prove successful from a technical point of view, even without the very useful accompaniment of the 14½ per cent. dividend which Mr. Geo. Offor, the able manager of the company, looks forward to with such confidence, it will give an immense impetus to the electric lighting of towns and the electric lighting industry generally.

Should it fail, the South Eastern Brush Company will have deserved well of all interested in the future of electric lighting, and must also take credit for having used its capital in an exemplary manner, which is more than can be said for the majority of electric light companies.

Colchester, too, will live long in the history of electrical enterprise as the firm supporter of the most important electric light installation attempted in this country up to the present time.

NEW METHOD OF MEASURING THE INTENSITY O AN ELECTRIC CURRENT IN ABSOLUTE UNITS.

By HENRI BECQUEREL.

TO measure the absolute intensity of an electric current, we employ generally either the tangent galvanometer or the electrolysis of a salt of silver. The use of the tangent galvanometer requires the very difficult measurement of the exact dimensions of the apparatus. It has the grave inconvenience of referring the intensity required to that of the terrestial magnetic field, which is never exactly known within about $\frac{1}{200}$, and which is variable, not only from one point to another, but also from one instant to another at the same place. Thus, the electrolysis of a silver salt is often adopted in preference. The operation is difficult to execute with precision, as the weight of silver collected indicates merely the total quantity of electricity which has traversed the voltameter. To deduce from this value the intensity, we must assume that the current has been rigorously constant during the whole duration of the experiment.

For some years I have been led to measure the absolute intensity of a magnetic or electro-magnetic field by observing the rotation of the polarisation-plane of light traversing a body placed in this field. (See *Comptes Rendus*, Vol. LXXXVI., p. 1,095.) This method is easily applied to the absolute measurement of an electric current upon the basis of the following theorem :—

Let us suppose a circular current of the intensity i, and an indefinite right line passing through its centre and perpendicular to its plane. We can demonstrate very simply that the sum of the projections upon this right line of all the electro-magnetic action exerted upon all its points, from $-\infty$ to $+\infty$, is independent of the radius of the circle, and equal to $4\pi i$. If, in place of a single current we have a bobbin holding N coils of wire, and traversed by a current of the intensity i, the sum of the actions exerted upon all the points of the axis parallel to this axis will be $4\pi N i$, and will depend only on the absolute number of coils on the bobbin, and on the intensity of the current.

Let us now arrange along the axis of the bobbin a tube, which we will at first suppose indefinite and full

of carbon bisulphide at 0° C. Suppose, further, that a ray of light, polarised rectilinearly, traverses this tube; the action of the current will give rise to a rotation of the plane of polarisation, and if we call a the rotation which corresponds, for the luminous rays considered to 1° of carbon bisulphide placed in a magnetic field equal to the unit (C.G.S.), the total rotation across the tube will be $4\pi N i a$. Practically the tube is cut off by parallel glasses at a small distance from the bobbin. We neglect then a portion of the action of the current, which for every turn is represented by $1 - \cos. \omega\,\omega$, being the angle at which the radius of this turn is seen from the extremity of the tube. If we calculate this correction for the last turn of the last range of wire in each bobbin, this value, $1 - \cos. \omega$, will give the upper limit of the difference between the rotation observed and that which would correspond to an infinite length of the tube. If the diameter of the bobbin does not exceed 5°, limiting the the tube to 1·50 metres on either side of the bobbin, the correction would not reach 0·0001.

Generally, we have no need of so close an approximation. It is therefore seen that to carry out the experiment a tube of 1·50 m. to 2· m. will be sufficient, closed by parallel glasses and filled with carbon bisulphide. In the middle of the tube we place a small bobbin (to the size of which we shall refer below), then at the two extremities of the tube we arrange a shadow-polarimeter and an analyser mounted on a graduated circle. The apparatus is illuminated with the yellow light of a a sodium-lamp, and if we observe a rotation, R, the intensity of the current passing into the bobbin will be given by

$$i = \frac{I}{4\pi N}\,\frac{R}{a}$$

It is therefore sufficient to know the absolute number of the turns, N, of the wire of the bobbin and the constant a. The accuracy of the results depends on that of the determination of this constant.

I have been led, many years ago, to measure this number by the direct action of terrestrial magnetism, and I have obtained for the rotation of the yellow rays, D, traversing 1° of carbon bisulphide at the temperature 0° C in a magnetic field equal to the unit C.G.S., the value $a = 0'\cdot0463$. The conditions of the experiment do not allow of an approximation closer than $\frac{1}{1000}$. I am at present engaged with determining this number with a greater exactness by the same method which forms the subject of the present paper.

The number just quoted enables us to find the degree of approximation with which we can measure the intensity of an electric current by this method. By making use of a bobbin holding 5,000 turns, a current of 1 ampère would give a rotation of 291′ for the yellow rays, D. If we reverse the direction of the current, we have 582′. But in the optical measurement we cannot make an error of 1′, we can easily go to 0·5′, so that it is very easy to obtain an approximation of 0·001 ampère in the measurement of the intensity. We may, without great difficulties in construction, effect a still greater approximation by multiplying the number of turns of wire on the bobbin.

We have supposed the carbon bisulphide to be of the temperature of 0° C. If the temperature is higher the rotation decreases. The formula of connection indicated by Bichat is $r = r_0 (1 - 0{\cdot}00\,104\,t - 0{\cdot}0000\,14\,t^2)$. It will be seen that this correction is about $\frac{1}{1000}$ for 1°, and as we can easily find the temperature of the carbon bisulphide within less than 1°, there will be no appreciable error occasioned by the determination of the temperatures. It is important to note, as one of the great advantages of this method, that the current traverses only the body which serves to make the measurement, and that it does not thus directly bring on a disturbance of temperature inherent in the passage of the electricity; moreover, it is very easy to preserve the carbon bisulphide from being heated by the bobbin.

If, lastly, we add that the indications of this apparatus are instantaneous, it will be seen that this method combines the advantages of the processes hitherto employed without their defects, since it gives results independent of terrestrial magnetism, and that it does not involve any measurement of the dimensions of the apparatus. It is sufficient to count the absolute number of the coils on the bobbin employed.

This method seems the most practical and exact for standardising the magneto-electric ampèremeters, the use of which is so common in laboratories and in the arts.—*Comptes Rendus.*

NOTE ON THE THEORY OF THE MAGNETIC BALANCE OF HUGHES.*

By PROF. SILVANUS P. THOMPSON, B.A., D.Sc.

(*Continued from page* 502.)

For those values of n which lie between 4 and 6 inclusive, the first half of the curve is very nearly a straight line, so nearly so that for the curves $n = 4$ and $n = 5$ the values of the ordinates do not differ by 1 per cent. from those which they would have for actual straight lines lying along the mean slope of the respective curves as far as 45°. In other words, for angles less than 45° *the*

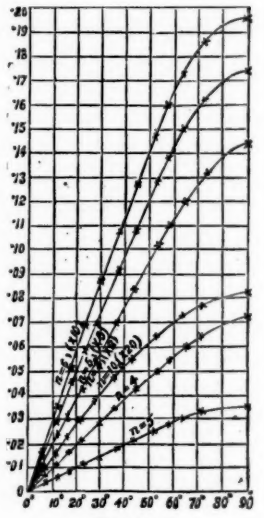


FIG. 3.

magnetic force exercised along the axis of the balance by the compensator when it is turned *is proportional*, within 1 per cent. of accuracy, *to the angle through which it has been turned, provided the distance of the compensator from the needle be not less than four and not greater than five times the half-length of the compensator.*

This result may be verified from equation (2) by finding what value of n will give the force when $\phi = 45°$ equal to $\frac{3}{4}$ of the force when $\phi = 30°$. Writing in the sines of these angles and equating 3 times the force at 30° to 2 times the force at 45°, we get the value $n = 4{\cdot}6$. Or, solving similarly for the case that the force at 60° shall be double the force at 30°, we get $n = 4{\cdot}28$. Here, however, the errors near the intermediate angle of 45° are not inconsiderable, exceeding 4 per cent. In any case we shall not be far wrong if we adjust the balance so that $n = 4{\cdot}5$, and confine our readings within 45° of zero. For purposes where great accuracy is not essential the readings might be extended as far as 60°, since the curves for $n = 4$ and $n = 5$, show how very little the straight line is departed from up to that point. In the original balance of Hughes, the values of r and l are about 30 centims. and 7·5 centims. respectively, so that $n = 4$.

4. I now proceed to the consideration of the action of the compensator in affecting in different positions the sensitiveness of the needle.

In the original instrument of Hughes, the compensator turned in a horizontal plane; and therefore in every position, save only when at 90° to the zero of its scale or when end-on to the indicating needle, the force exercised by it on the needle would have a component in the magnetic meridian. As remarked above, the effect of this component would be to increase or diminish the directive force of the earth's magnetism upon the needle, according as the S pole of the compensator pointed northwards or southwards. The sensitiveness of the indicating needle will, of course, be affected by this component; being a maximum when the component is such as nearly to astatise it. But it is evident

* From the proceedings of the Royal Society, No. 230, 1884.

that if the needle be nearly astatised when the compensator is at zero, it will not be so astatised when the compensator is moved right or left. The sensibility of the needle will diminish as the effective force of the compensator increases by its being turned. The calculation for the component of the force at this point is as follows :—

Calling T the part of the magnetic force at B (fig. 1) resolved at right angles to A X, we have—

$$T = m\left\{\frac{\sin.\ \alpha}{r'^2} - \frac{\sin\beta}{r''^2}\right\}.$$

But $$\sin\alpha = \frac{l\cos\phi}{(r^2 + l^2 - 2rl\sin\phi)^{\frac{3}{2}}},$$

and $$\sin\beta = \frac{l\cos\phi}{(r^2 + l^2 + 2rl\sin\phi)^{\frac{3}{2}}},$$

whence

$$T = ml\cos\phi\left\{\frac{1}{(r^2 + l^2 - 2rl\sin\phi)^{\frac{3}{2}}} + \frac{1}{(r^2 + l^2 + 2rl\sin\phi)^{\frac{3}{2}}}\right\}.$$

Writing, as before, $r = n\,l$, this becomes :—

$$T = \frac{m}{l^2}\cos\phi\left\{\frac{1}{(n^2 + 1 - 2n\sin\phi)^{\frac{3}{2}}} + \frac{1}{(n^2 + 1 + 2n\sin\phi)^{\frac{3}{2}}}\right\} \quad (3).$$

Assuming that the balance is adjusted for the case $n = 5$, we get the following values for this complex function of ϕ :—

$$\phi = 0, \quad T = \frac{m}{l^2} \times \cdot01508.$$

$$\phi = 30°, \quad T = \frac{m}{l^2} \times \cdot01402.$$

$$\phi = 60°, \quad T = \frac{m}{l^2} \times \cdot00938.$$

$$\phi = 90°, \quad T = \frac{m}{l^2} \times 0.$$

The needle, therefore, if nearly astatised when $\phi = 0$, will still be nearly astatised when ϕ does not exceed 30°; but beyond this value the meridional component of the force falls off greatly, and the sensitiveness alters correspondingly.

5. *Suggested Modifications in the Magnetic Balance.*—The preceding investigation has led to the following suggestions :—

1stly. The compensator should be set so as to revolve against a vertical circle placed at right angles to the magnetic meridian, having its centre on the same level as the indicating needle, and magnetically east or west of it. In this position, which was that chosen for the experiments in which the values of P were observed for the purpose of comparison with the calculated values in the preceding part of these notes, the magnetic force of the compensator has no resolved part in the magnetic meridian at the point where the indicating needle is placed. The sensitiveness of the needle is, therefore, the same in all positions to which the compensator may be turned in its own plane.

2ndly. A small magnet, lying magnetically north and south of the indicating needle is used to astatise it to the required degree.

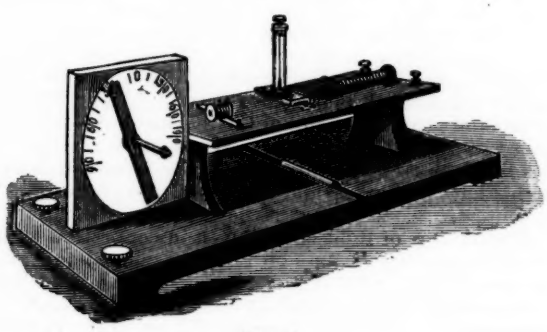


FIG. 4.

3rdly. The compensator is placed so that the distance between its centre and that of the indicating needle is about 4·6 times the half-length between the poles of the compensator. If the latter be a not very thick flat straight magnet, it may be approximately assumed that the poles are about one-tenth of the whole length from the ends, so that *no very important error can arise if a distance equal to five times the half-length between the ends of the magnet is selected.* When this is done it is safe to assume that *for all positions if the compensator, within 55° on either side of zero, the magnetic force which it exerts on the pole of indicating needle is proportional within 2 per cent. to the degrees of the scale through which the compensator has been turned, and is proportional within 1 per cent. for angles less than 45°.* For the practical purposes for which the magnetic balance is designed there will, therefore, be no need of a special calibration table.

4thly. As it is inadmissible to obtain a great range of compensation for both large and small magnetic forces by diminishing or increasing the distance of the compensator from the indicating needle, it is proposed to obtain this range by placing over the compensator a second magnet, capable of rotating round the same axis, and having the same length between its poles. A third magnet may be added, similarly, to increase the magnetic moment of the compensator.

5thly. In the preceding investigation it has been assumed throughout that the length of the indicating needle was small relatively to r and l, so that the terms of the second and higher orders due to its length might be neglected. This was not the case in the original instrument of Hughes, in which the needle was 5 centims. in length. The use of a very small needle is open to the objection that it is not so sensitive as an index. It is, therefore, proposed to substitute as an indicating needle one of the type sometimes termed "unipolar," that is to say, having one pole set in the axis of rotation, so that only one pole has a moment of couple about the axis of suspension. A steel needle about 5 centims. long has about 1·5 centims. of its length turned up at right angles, the suspending fibre of silk being attached to the turned-up end; a counterpoise is added behind, and a small additional weight is placed below on a brass wire attached immediately below the centre of suspension. This needle is placed, with its one effective pole in the axial line of the balance, level with the centre of the compensator.

The balance, with the modifications described, is represented in fig. 4.

BURKE'S SYSTEM OF TELEGRAPHY.*

NOTWITHSTANDING the remarkable activity displayed in the field of electrical invention during the past few years, comparatively little attention has been directed to the improvement of telegraphic systems, which could successfully be adapted to communication by long submarine cables. Very few inventors are sufficiently familiar with the results already attained to warrant them in devoting their time to this branch, while the opportunities offered for practical experimenting are very meagre.

The system invented by Charles G. Burke, and patented March 25, 1884, while not confined to cable telegraphy, seems admirably adapted for such work, and is certainly of sufficient interest as an entirely new departure in that direction, to entitle it to a prominent position as a most ingenious conception in the field of electrical devices.

The Burke system is based upon a division of the alphabet, into two groups, which may respectively be designated as left and right hand groups; these groups

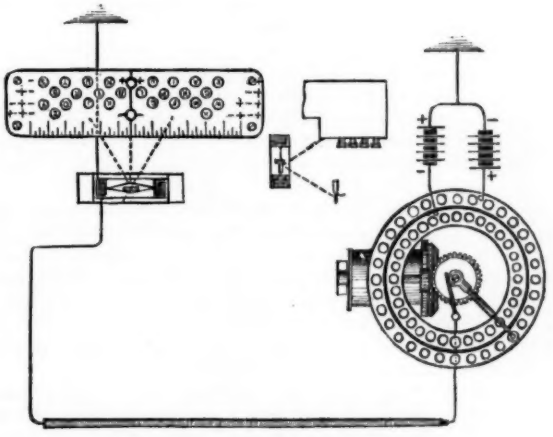


DIAGRAM OF THE BURKE SYSTEM.

are each arranged in four divisions, and each division into four positions. The groups are recognised by a correspondence of deflection in the galvanometer needle; the divisions of the groups by the number of such deflections, and the letters in the division by a period of time from the designation of the division and agreeing in the number of its units with the numerical position of the letter in such division. For submarine cable purposes, alternate positive and negative impulses are found most effective, and consequently in this system it is so arranged that consecutive impulses of

* From the *New York Electrician.*

like polarity are never required in the elements which constitute a complete signal.

As an illustration of the method of operation it may be assumed that the alphabet is arranged as follows:

Left hand group.				Right hand group.			
1	2	3	4	1	2	3	4
1—e	a	i	o.	1—s	t	u	n
2—c	h	p	l.	2—b	y	r	d
3—w	m	f	g.	3—k	j	q	v
4—x.				4—z			

In this case the left hand group is designated by a deflection of the galvanometer needle to the left, and the right hand group by a corresponding deflection to the right. If, for instance, the first division of the left hand group was to be designated, then a current is sent to line that will cause a deflection of the needle to the left; if the second division of such group was intended, it would require two motions of the needle, and as it is essential to avoid successions of similar polarity, the primal motion always determines the side, so that the second motion may be in the opposite direction, and, consequently, the result of a change of polarity. As there are four letters in each of the three first divisions of the two groups, the time required to designate them is divided into four units of equal duration, and to designate any particular letter, a number of units of time corresponding with the relative numerical position of the letter must be required.

For instance, in the foregoing table it will be seen that the letter "p" is the third letter in the second division of the left hand group. To designate "p" would, therefore, require two electrical impulses: the first deflecting the needle to the left, the second to the right, and then a pause for three units of time. The time measurement may be readily determined by the use of a metronome arranged to beat in consonance with the transmitting apparatus; but as there is at most only four units or periods to be recognised, a little practice will render mechanical aid quite unnecessary.

The arrangement of the letters is intended to be in accordance with the frequency of their usage in the prevailing language, and they are so placed that those most in use will require the least number of electric impulses for their indication.

It will be observed that the pulsations employed for indicating the divisions are each composed either of a single current or of a series of currents of alternating polarity. Such a combination of currents effectually prevents any detrimental results which have heretofore been encountered from a static condition of the main line or cable.

It is well known that the effect of a current of opposite polarity succeeding any given current is to neutralise the static discharge which otherwise succeeds the interruption of the preceeding current. The time which lapses between the indication of any two successive groups of letters is sufficient to allow the static discharge of the last current employed to take place before the next succeeding group is indicated.

In connection with his system, Mr. Burke has designed a transmitting and receiving device which greatly facilitates its operation, and which enables persons of ordinary intelligence to become proficient operators.

The transmitter is a series of keys arranged in circular form, each key corresponding with a letter of the alphabet, and which, when depressed by the operator, will automatically send to line the necessary electric impulses to affect the galvanometer, so as to designate the group and division in which the letter is, and, at the same time, measure off at the conclusion of the group and division signal, a period of time corresponding with the position of the letter This is effected in the following manner: the key board consists of two metallic rings insulated from each other, and connected respectively with the sources of electric energy of dissimilar polarity. Through the two rings and radially from the centre, are bored a series of holes at regular distances from each other, through which pass connecting metallic pins, and which may be thrown into the pathway of a circuit-closing arm rotating beneath them. These pins are so arranged that only one can be in contact with the rotating arm at one time, so that no matter how many may be depressed they must always be operated upon in regular and pre-determined succession. The operator is thus enabled to depress as many keys as may be desired in advance of the rotating arm, and they will be taken in their regular order, their various combinations of impulses and time measurements sent to line, and the key restored to its normal position for further operation. By an indicator above the key board, which travels in the same line with the circuit-closing arm, the operator can always tell what keys he may use, and, as he has not to wait for the making of the contacts of the keys he has depressed, he can follow the indicator in its round and avail himself of any key beyond which it has passed, so that there is no loss of time. As an illustration of the arrangement of the keys we will take the letter "p." Referring to the table it will be seen that that letter is in the second division of the left hand group, and is the third letter in the division. To designate this letter two electric impulses must be given, and three units of time. The key which corresponds with this letter must, therefore, combine, first, a pin to give a positive impulse, followed by a pin to give a negative impulse, and then a blank space equal to the time of three impulses, and then another pin to give a closing impulse to complete the signal. The top of the key which is circular, extends over all the pins necessary to complete the signal, but is not attached to either of them, so that whilst by its depression all the pins beneath it are simultaneously thrown into the pathway of the circuit-closing arm, they are returned under the key head only in the order of their operation, the return of the key top being effected by a means independent of the circuit-closing arm. It will be seen that the transmission involves no skill on the part of the operator beyond a facility to keep up with the indicator, and that the signals must be mathematically correct in their transmission, and very plain and distinct to the receiver.

To aid the receiver the inventor has designed a type-printing device, the keys of which are arranged to correspond with the arrangement of the alphabet, so that the signals when received will positively indicate the letter intended. Taking again, for instance the letter "p," the receiving operator will first recognise that the galvanometer is deflected to the left, he knows, therefore, that it is the left hand side of his key board which is intended, then comes a second signal which means the second division of the left hand side, then a pause of three beats and a final closing signal, so he has but to depress the third key in the second division of his left hand group and the transmitted letter "p" is printed.

Where a ray of light is employed in connection with the galvanometer it may be readily arranged to have its zero in the centre of the receiving key board; but as no certain degree of deflection is required, a scale is unnecessary, and the operator has simply to observe the direction of the first movement and the total number of distinct signals.

It will be observed that this system involves no change of circuits or increase of battery, and that the same delicate instruments now employed to receive are retained, but it must be apparent to any one who appreciates the conditions incidental to long submarine cables, that it meets all such conditions with the very means best adapted to overcome the obstacles which they present to facility and rapidity of transmission, and must greatly increase the capacity of cables for telegraphic work.

If it is desired to employ electric currents of different strengths for furnishing indicating signals, the same system of divisions is applied, the positive current being replaced by currents of a given strength, and the negative currents by currents of a greater or of less strength. The currents of different strengths may be of the same or of opposite polarity, as desired. Like-

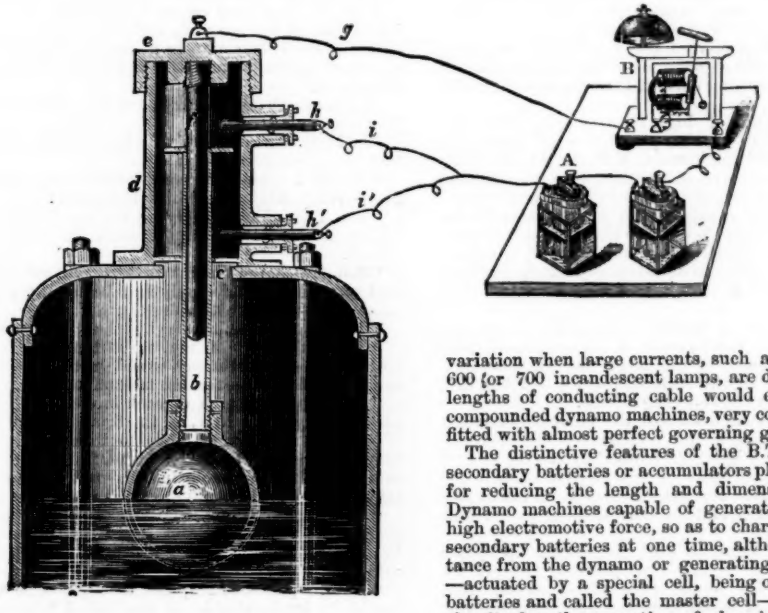
wise the substitution of currents of different durations may also be effected by assigning a current of a given duration in place of a positive current, and a current of another and distinctive duration in place of a negative current, wherever those currents occur in the system first described.

This system, apparently, opens a new and wide field for inquiry, and must be especially valuable for telegraphic purposes wherever a minimum of battery use, and a maximum of line discharge are requisite, or desirable; it ought also to make the transmission and reception of telegraphic messages much more simple than under the present system, since the codes which are possible by it will be to a marked degree self-teaching and easily comprehended.

As in most new inventions of this character, actual practice will doubtless develop defects which must be eradicated, or suggest improvements that will render the system still more desirable. The principle, however, appears to be novel, and it may possibly be adapted to other uses which have not as yet received consideration.

AN ELECTRIC HIGH AND LOW WATER ALARM.

IN this invention of Messrs. Southey and Rusden an alarm is caused to be sounded automatically whenever the water in a steam boiler reaches the high or low water level. The construction of the alarm is shown in the diagram.



A galvanic battery, A, and bell, B, are fixed in any convenient position, and a float, *a*, is placed upon the water in the boiler, which float rises and falls with the water. To the float, *a*, is attached a metal tube, *b*, flanged at the top, rising perpendicularly through an aperture, *c*, formed in the boiler shell. Surrounding and covering this aperture, *c*, is a vertical chamber, *d*, to the cap, *e*, of which chamber is connected a rod, *f*, in connection by means of a wire, *g*, with the bell, B, which rod, *f*, passes down the tube, *b*, attached to the float. Upon the float rising and falling, the tube aforesaid slides up and down the rod, *f*. In the circumference or side of the vertical chamber, *d*, are introduced two contact rods, *h*, *h'*, bushed with any suitable insulating material and connected by wires, *i*, *i'*, to the battery, A. One of these contact rods, *h*, is placed near the top of the chamber, *d*, and the other, *h'*, is placed at the lower part of the chamber, the upper rod being for high water level, and the lower one for low water level.

The action of the alarm is as follows:—Upon the water in the boiler rising and falling, the float, *a*, and tube, *b*, are carried with it, and upon reaching the level of either of the contact rods, *h*, *h'*, contact is made with the flange of the tube, *b*; the electric circuit is thus completed, and the alarm bell or bells are sounded.

The apparatus is simple in construction, effective it is said, in operation, and all the parts are easy to disconnect for repairs and cleaning, should either be required at any time.

We should imagine that an extensive use will be made of this simple alarm, which scarcely needs any other recommendation than its self-evident merits.

THE B.T.K. SYSTEM OF ELECTRIC LIGHTING.

ONE of the aims of the system which the South Eastern Brush Electric Light Company has commenced to install in the town of Colchester is *decentralisation* in the broadest sense of the word as far as regards the station from which the supply of electricity is given, and the other is to make the supply entirely independent of the moving machinery, so as to avoid as much as possible the liability to sudden stoppages from any cause.

An examination of the problem of electric lighting direct from the dynamo machine will show that the maintenance of a standard electromotive force, with an allowance of, say 5 or 6 per cent. variation when large currents, such as would be required for, say 600 (or 700 incandescent lamps, are driven along even moderate lengths of conducting cable would entail the use of perfectly compounded dynamo machines, very costly conductors, and engines fitted with almost perfect governing gear.

The distinctive features of the B.T.K. system are the use of secondary batteries or accumulators placed in favourable positions for reducing the length and dimensions of conducting cables. Dynamo machines capable of generating electric currents of any high electromotive force, so as to charge a large number of these secondary batteries at one time, although situated at a long distance from the dynamo or generating station. Rocking switches—actuated by a special cell, being one of any set of secondary batteries and called the master cell—which break the charging circuit when the operation of charging is completed, and which shunt the stored current on to the mains and service wires for the supple to consumers, and which at the same time converts the high electromotive force which existed during the charging process to the standard E.M.F. required by the lamps in use. For this purpose there are alternate sets of batteries and rocking switches, so that while one set of batteries is being charged the other set is in supply, and by the time the maximum current is required, say, in the evening, both sets of batteries will have been fully charged, and will therefore have been cut out of the charging circuit, and will be connected to the supply mains.

This alternation of sets in charge and supply is said to be made quite automatic, so as to require no attention to this part of the plant beyond an occasional inspection.

The engine for driving the dynamo machines was built by Messrs. Davey, Paxman & Co., of Colchester, and is of 25 H.P. nominal, semi-portable type, and capable of exerting 90 horse-power, when working at 133 revolutions per minute. It is connected by belting from the fly-wheel, which is 7 feet in diameter, to a 4 feet 6 inch pulley on the countershaft, and from pulleys of 5 feet diameter on the countershaft, by belting, to two No. 8 Brush dynamo machines.

These are the largest machines of this type at present made, but a demand for machines giving twice the current at the same or a higher E.M.F. will no doubt be met as required.

The machines at present in use give a current of 9·5 to 10

ampères at an E.M.F. of about 1,800 volts, when rotated at a speed of 700 to 750 revolutions per minute. They are connected together in parallel arc, or for quantity, thus acting as one machine, and giving a current up to nearly 20 ampères.

Some little difficulty was at first experienced in arranging the two machines for running together, so that each produced its quantum of the work, and so balanced the work of the other. The machines being originally constructed for arc lighting, also required some modification to convert them to their present purpose, and they are therefore separately excited by means of a small "Victoria" dynamo, which passes a current of about 10 ampères round the field-magnet coils of each.

This "Victoria" dynamo machine was constructed to specification by the Anglo-American Brush Corporation for the South Eastern Brush Company, and gives an E.M.F. of 150 volts when working through an external resistance of 7·5 ohms.

This method of excitation of the magnetism allows of great adjustment of the strength of the magnetic field, so that the power expended in charging less than the maximum number of cells is nearly proportional to the number in charge at any time. The adjustment of the strength of the magnetic field of the large machines to the requirements of the circuit is accomplished by means of an automatic regulator, which limits the supply of current to the field-magnet coils in the large machines.

It consists of two electro-magnets, the armatures of which actuate contact-breaking apparatus in connection with a small electro-motor, and which cause the armature of the motor to rotate in either direction, according to the manner in which the connection is made with the source of supply. The rotation of the armature of this motor then actuates a sliding contact, which increases or decreases the resistance in the field-magnet circuit of the "Victoria" machine.

The charging current is passed through the coils of the electro magnets of the regulator, and fluctuations in the current have their effect on the armatures, causing them to be attracted or released according as the current is above or below the normal amount.

When, in consequence of an excess in the charging current, one of the armatures is attracted to its electro-magnet, connections are made to the motor in such manner as to cause its armature to rotate, and so actuate the sliding contact, and add resistance in the field-magnet circuit of the "Victoria" machine.

This decreases the electromotive force generated, and thus lowers the current in the field-magnet coils of the large machines until the strength of the charging current is again brought to its normal.

The generation of currents of high electromotive force by means of the Brush dynamo machine presents some difficulties when it is necessary that the maximum E.M.F. should be available at any instant. This arises from the fact that the current generated by these machines is not absolutely continuous, but is a series of waves or pulsations caused by the commutation of the current in which the circuit is broken three times in each revolution of the armature. As a result of this peculiarity it is impossible to run the machine in open circuit when separately excited, and to obviate this difficulty a switch and resistance was constructed.

The switch is mounted on a board carrying three current metres. One of these shows the amount of current circulating in the coils of the field-magnets of the large machines, another shows the current passing in the resistance coils, and the last shows the current passing in the charging circuit.

The first position of the switch carries the current generated by the large dynamos through the resistance coils, and the amount of resistance in ohms being multiplied by the reading of the current meter, gives the value of the electromotive force generated in volts, and on this reaching its maximum the switch is moved to the second position, and the current then passes into the charging circuit.

The resistance coils also serve to load the engine up to the amount of work required from it, and thus prevents the pull up and consequent strain which would take place, where from running almost light a load of 80-horse power were suddenly put upon it.

The rocking switch, by means of which apparatus the accidental presence of high E.M.F. in houses is an impossibility, as at the instant of breaking the circuit either of charge or supply both circuits will be interrupted for a moment, consists of two rows of 18 iron cups containing mercury, mounted at opposite ends of an insulating base. In the centre of this base a cradle is fixed, in which the rocking bar carrying the contact pieces is suspended by steel centres. Sixteen of the cups at one end of the base are connected alternately with the positive and negative poles of the cascades of batteries; the two remaining cups at this end being connected respectively to the positive and negative poles of the charging main. Connections are made on the under side of the base from the 16 alternate positive and negative cups to 16 of the cups at the other end of the base, so as to make eight cups on one side positive and the remaining eight negative. A pair of large cups, one at each side, carry the whole of the current to the positive and negative supply mains. The contact pieces carried by the rocking bar are in the form of prongs, which dip into the mercury cups. On the charging side they are in detached pairs mounted on an ebonite bar, so as to connect the positive end of one cascade of batteries to the negative end of the next cascade, and so on. On the supply side the contact prongs are mounted on two copper bars connecting all the positive ends of the cascades to one bar and terminal mercury cup, and all the negative ends to the other bar and cup, and from these terminal cups to the supply mains. The rocking switches are actuated by automatic means, which throw the batteries out of the charging circuit, when the charging process is completed, or so near completion, that free hydrogen is rapidly evolved from the positive electrodes, and this operation is carried out by means of the master cell.

This master cell is one of the ordinary battery cells, to which a simple arrangement is made for collecting the gas given off from one of the positive electrodes of the cell. The gas is collected in an air-tight chamber which partially encloses one of the positive plates, and which extends a short distance below the level of the dilute acid in the cell. In the top of this chamber is an orifice, in which is inserted a tube carrying a loose diaphragm, which is also made perfectly air-tight. On the top of this diaphragm a plunger rests, and this plunger actuates, by its rise and fall, according to the distension or contraction of the diaphragm, a small contact breaker, which makes or breaks a circuit through the electro-magnet which actuates the rocking switches.

It is evident, then, that on completion of the charging process, and consequent distension of the diaphragm by the free gas evolved, the charging current will be interrupted, and the current energy stored in the batteries will be made available for supply by the fall of the bar carrying the contact pieces or prongs on the discharge side of the rocking switch.

The form of electrode used in the B.T.K. batteries, made by the Consolidated Electric Company, has, it is claimed, several features rendering it distinct from any other form. The principle of the plate is the use of a band or tape of lead, cut from the sheet by machinery, which renders one side of the tape cellulated or roughened. In the latest form are used a number of very thin tapes, cut as described, and a thicker tape wound or coiled upon them to the required dimensions and pressed into shape. It is then burnt together at the corners to give rigidity when fitted with a cast lead support or pole-piece. It is then ready for "forming." Each cell of the battery contains 11 plates, the supports of which are connected alternately to copper bars on the outside of the cell, and the copper bars are then provided with a hook attachment for connecting the cells together.

They are supported on cast iron racks which rest on porcelain insulators on the ground, and they can be constructed of any capacity up to 360 ampère hours, the capacity depending on the degree of formation and the thickness of the active material of the plates.

In the question of cables one of the claims of the B.T.K. system for economy rests.

Mr. King, the company's electrician, gives the following information on this point:—

"We will divide our consideration of the cables necessary for the direct parallel system into two parts:

"1st. The cable for carrying the whole current from the generating station to the supply mains in Head Street and High Street.

"2nd. The supply mains in Head Street and High Street; we will suppose that the supply is to be equally distributed along the whole area, and on both sides of the road.

"1st. The cables for carrying the whole current.

"This would be in, say, three branches from the station in Culver Street; one branch would go to Head Street, and the two others to High Street in the most favourable positions.

"The average length of each branch, lead and return, will be about 333 yards. Now, as the total current required would be about 2,000 ampères, we have to transmit along each branch 666 ampères, a maximum of 2 per cent. fall in the electromotive force is the utmost allowable in this part of the circuit, and on a 60-volt circuit this would amount to 1·2 volts.

"The resistance of the largest cable we use is about $\frac{1}{7}$ or ·145 ohm per 1,000 yards, and if we used this size for our three branches, we should have a resistance in each of, say $\frac{1}{20}$ or nearly ·048 ohm.

"But to pass 666 ampères through such a conductor as this would be impracticable on account of heating, besides which it would take an electromotive force equal to 666 × ·05 or 33·3 volts. Our allowance for fall being limited to 1·2 volts, we should have to use a cable, the copper conductor of which would equal the sectional area of 27 cables, such as the largest we use, and the weight of the cable would be about 25 tons. This would cost at least £3,000 or £4,000.

"2nd. The mains for supply in High Street and Head Street.

"The total length required would be about 5,000 yards, which would be divided, or may be considered as divided, into twelve branches of equal length, each branch being about 416 yards in length, and supplying a maximum current of 166 amperes, with an allowance for variation in E.M.F. of, say, 2½ per cent.

"The resistance of 416 yards of this 19 No. 12 B.W.G. cable will be about ·06, and to calculate the fall in E.M.F. when using this cable we must multiply 166 by ·06, giving 9·96 volts. But as the current is supposed to be equally distributed, this amount will be divided by 2, and we should have a maximum fall of about 5 volts instead of 1·2.

"From this it will be seen that a cable would have to be used which would equal in sectional area $\frac{5}{1·2}$, or four of these 19 No. 12 B.W.G. cables. Now, as this size costs about £200 per 1,000 yards, it is fair to assume that a cable four times the weight would cost at least three times as much, or about £750 per 1,000 yards, and

as the total length is about 5,000 yards, the cost will be about £3,800, and making in all a grand total for cable of £7,000 or £8,000.

"I cannot better contrast the cost of cables on the two systems than by the statement that the whole for the supply of 2,000 incandescent lamps on the B.T.K. system have cost about £1,200. The figures speak for themselves, and need no further comment."

The cables as laid for the B.T.K. system are in 21 parallels, each distinct from the other, and branching from six battery stations. This division avoids the use of distributing boxes, and enables the electricians to test any length independently of the rest. They are laid in a brick trench built directly under the pavement, and having wells at distances of 50 feet apart to allow of drainage. The internal dimensions of the trench are 9 inches by 7¼ inches, which is ample space for three or four times the amount of cable laid.

The road crossings are taken below the surface of the road, and the channel is supplied with a cast-iron cover, made in short lengths, and with lap joints. The cables can be reached at any place by simply raising a paving-stone when junctions for services are requisite, and the pavement can be made good again in a short time.

THE TANGENT-GALVANOMETER AS AN AMPÈRE-METER.

By J. KESSLER.

IN the following memoir the main object is to give in the simplest possible manner the measurement of the ampère, the unit of current introduced in 1881 by the Paris Congress of Electricians. Thereby on the one hand, it is sought to show the connection with the theory of electro-magnetism, and with the absolute system of measurement of theoretical mechanics. On the other hand, the construction of instruments is sought, with which, without any previous measurement, the strength of the current can be given in ampères, without any tedious calculation, simply by means of a table of the geometric functions.

Councillor Herr Stefan in his address on the historic development of the electro-magnetic system of measurement, as delivered before our Association, March 10th, 1884, asserted that the tangent-galvanometer is, above all others, the ampèremeter. He stated that with reference to the present value of the horizontal components of terrestrial magnetism in our districts, the radius of the tangent-galvanometer in centimetres must be selected in approximation to ten times Ludolf's number in order at an angle of deviation of 45° to give the absolute unit of current—10 ampères.

The author, induced by an essay by Dr. F. Kohlrausch, had been previously engaged in the measurement of currents, and with reference to the present horizontal components at Vienna had constructed a tangent-galvanometer, in which, by a suitable selection of the radius, the strength of the current is given in absolute measurement by the simple tangents of the angles of deviation, and in ampères by ten times the tangents of the same angles.

It may, perhaps, not be superfluous to follow the theoretical course with the utmost brevity and plainness. After Oersted had established the fact of the deflection of the magnetic needle by the electric current, Biot and Savart took up the geometry of this phenomenon. Laplace also gave it his attention and explained the result—in analogy to Newton's law on the phenomena of gravitation—by the assumption that the action of the current is inversely as the square of its distance from the magnetic pole.

But the action of a rectilinear portion of a conductor is not in all positions the same with reference to the magnetic pole, but depends on the angle between the portion of the conductor and the line which joins it to the magnetic pole. If we assume that the action of an electric current, i (fig. 1), in the very small length of a conductor, σ, inclosing the angle, Θ, with the line, R, which connects it with the pole, m, is expressed by the formula

$$\frac{i\,\sigma\,m\,\sin\Theta}{R^2}$$

the calculation always agrees with experiment.

In the tangent-galvanometer of W. Weber—shown in a diagram in fig. 2—the electric current is led circularly in one or more turns around a small magnet placed in the centre, so that for a diameter which is at least 12 times the length of the magnetic needle, the angle, Θ, is always close upon 90°. If the piece, A x, which brings the current, and the piece, B y, which conducts it away, are placed parallel and near to each other, which is sufficient for a few metres, the entire force of the current, F, which tends to move the magnet, m, in a direction normal to the plane of the circle is, according to the above formula, the sum

$$F = \Sigma\frac{i\,\sigma\,m\,\sin\Theta}{R^2} \qquad \text{I.}$$

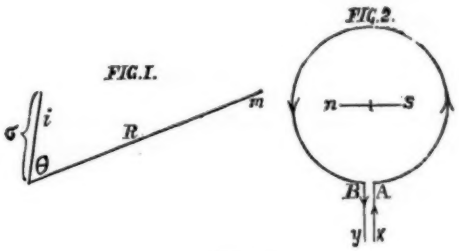
As Θ is always close upon 90°, $\sin\Theta = 1$, and i, R, m, is constant for all the elements of the current, therefore

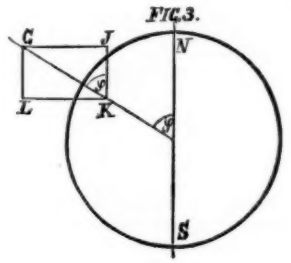
$$F = \frac{i\,m}{R^2}\,\Sigma(\sigma) \qquad \text{II.}$$

and if we put $\Sigma(\sigma) = 2\,R\,\pi\,n$ then

$$F = \frac{2\,\pi\,i\,m\,n}{R} \qquad \text{III.}$$

Hence it appears that for the tangent-galvanometer the action of the current is directly proportional to the strength of the current and the number of the





coils and inversely to the 1st power of the radius.

If we calculate from formula II.—

$$i = \frac{R^2\,F}{m\,\Sigma(\sigma)}$$

there follows with reference to the preservation of the connection with the absolute system of measurement of theoretical mechanics, a very simple definition of the absolute unit of the strength of the current, on the centimetregramme system—

for if R = 1 centimetre,
F = 1 centimetregramme,
m = 1 unit of magnetism,
$\Sigma(\sigma)$ = 1 centimetre, *i.e.*, one circuit of the unit of length.

The absolute unit of the strength of the current according to electro-magnetic measurement, known also as the current unit, is the strength of a current which in passing through an arc of a circle of the length 1 and the radius 1, exerts the force 1 upon a pole 1 (or the magnetic quantity 1) which is found at its centre.

If the entire circle is 6·28 times greater than the above mentioned arc (equal in length to the radius),

then a current of the intensity 1, will be that which in traversing a circle of the radius 1, exerts upon the pole at the centre the force of 6·28, or more correctly 2π absolute units.

In so small dimensions it is scarcely possible to determine the absolute current-unit practically with the aid of Weber's tangent-galvanometer.

The dimensions of the tangent-galvanometer become favourable and sufficiently large for use if it is constructed according to the first principle given by Weber, in which the magnetism of the earth is used for the measurement of currents.

Let (fig. 3) N S, be the section of the magnetic meridian, into which the plane of the circuit is moved, the horizontal plane of the circuit being that in which a dipping-needle vibrates.

For the case of equilibrium the resultant of the current action, L K, and the horizontal component, K J, of the terrestrial magnetism passes to the pole, m, through the axis of the needle.

Then $$\frac{J\,G}{K\,J} = \text{tang. } \phi = \frac{L\,K}{K\,J}$$

therefore $$L\,K = K\,J \text{ tang. } \phi.$$

But $L\,K = \frac{i\,m}{R^2}\,\Sigma\,(\sigma)$ according to II.

And as $$K\,J = H\,m$$

the action of the terrestrial magnetism upon the mass, m, when the action upon the unit of mass is denoted by H, will therefore be

$$\frac{i}{R^2}\,\Sigma\,(\sigma) = H \text{ tang. } \phi,$$

from which formula m is eliminated, whence it results that different needles with the same strength of current give the same deviation.

If we now put

$$\Sigma\,(\sigma) = 2\,R\,\pi\,n$$

and therefore take n coils of the circuit, we have

$$\frac{i\,2\,R\,\pi\,n}{R^2} = H \text{ tang. } \phi,$$

whence arises

$$i = \frac{R\,H}{2\,\pi\,n} \text{ tang. } \phi \qquad \text{IV.}$$

the formula of Weber for determining the strength of the current i, in absolute measurement.

For the absolute unit of current at an angle of 45° in a tangent-galvanometer with one coil, we have—

$$\text{absol. } 1 = \frac{R\,H}{2\,\pi}$$

or

$$R = \frac{2\,\pi}{H} \qquad \text{V.}$$

Hence there results a definition of the current unit, which can easily be demonstrated by experiment :—

"The absolute unit of the strength, or the strength of a current of 10 ampères, is that which in a tangent-galvanometer of one coil, whose radius in centimetre grammes is double the Ludolf's number divided by the value of the horizontal component of the terrestrial magnetism, gives an angle of deviation of 45°."

In an analogous manner the definition of the strength of current of 1 ampère on the electro-magnetic system of measurement is as follows :—

"An ampère is that strength of a current which in a tangent-galvanometer of the above dimensions, but of 10 coils likewise, gives an angle of deviation of 45°."

If we have at hand a table of the values of the horizontal component of terrestrial magnetism, such as the following one drawn up by Prof. Kohlrausch, we have the necessary datum for the dimensions of such a tangent-galvanometer in centimetres :—

LONGITUDE FROM FERRO.

North Lat.	20°	25°	30°	35°	40°
45°	0·209	0·212	0·217	0·221	0·225
46°	0·205	0·208	0·213	0·217	0·221
47°	0·201	0·204	0·209	0·213	0·217
48°	0·197	0·200	0·204	0·209	0·213
49°	0·193	0·196	0·200	0·205	0·208
50°	0·188	0·192	0·196	0·200	0·204
51°	0·185	0·188	0·192	0·196	0·200
52°	0·181	0·184	0·188	0·192	0·195
53°	0·177	0·181	0·185	0·188	0·191
54°	0·174	0·177	0·182	0·184	0·187
55°	0·169	0·175	0·178	0·181	0·183

For central Europe the value of the horizontal component is about 0·2 centimetregramme, so that approximately the radius of such an instrument $R = \frac{2\,\pi}{0{\cdot}2}$ is about 30 centimetres in length.

This radius is not too small for practice, and a compass of this kind with one coil will be described below. As the strengths of the current are proportional to the tangents of the angles of deviation they give for an apparatus constructed with this radius, the strengths of the current in an absolute measurement, or respectively the tangents multiplied by 10 give the strength of the current in ampères.

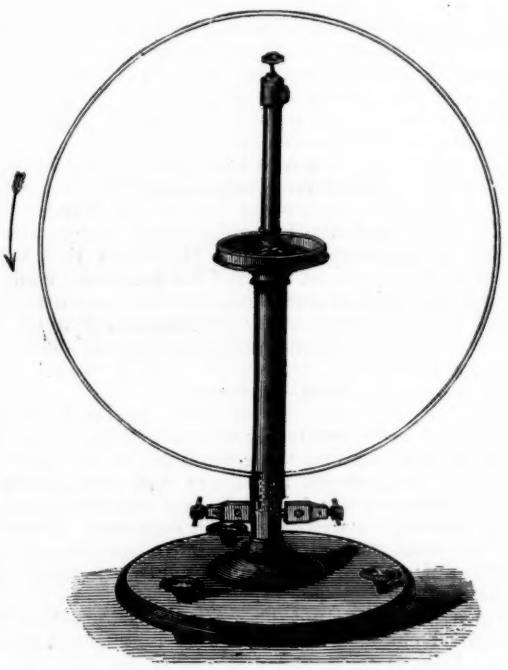


FIG. 4.

As regards the alteration of the value of the horizontal component in time, it must be remarked that, in the course of the next four years, it will be increased by a unit in the third decimal place; a change which in ordinary practical measurements is not important, and which, in case of need, can be corrected in the calculations.

In accordance with the present value of the horizontal component of terrestrial magnetism for Vienna, H = 0·208, the author has had a tangent-galvanometer with one coil, constructed by the mechanician F. Kröttlinger, which, at an angle of deviation of 45°, shows the absolute current unit, or 10 ampères.

It consists (fig. 4) of a pedestal with three brass set-screws, upon which is screwed to a strong wooden pillar a circuit of copper wire 7 millimetres in thick-

ness. The radius of the circuit with reference to the formula V is $R = \frac{2\pi}{H} = \frac{2\pi}{0{\cdot}208} = 30{\cdot}20$ centimetres.

In the centre of the circle there swings in a wooden box a magnetic needle suspended by a cocoon-thread.

It consists of the hardest steel, and is a small rhombic prism 4 centimetres in length. A thin brass index is fixed in a direction normal to the length of the needle, and plays against a graduated quadrant of silver with blackened degrees, on which, by reason of its considerable diameter (140 millimetres), fourths of a degree can be easily read off.

(To be continued.)

THE MERCURIAL GALVANOMETER OF M. G. LIPPMANN.*

La Lumière Electrique inserted, in its last number but one, a note (also published in the last issue of the ELECTRICAL REVIEW) presented by M. Lippmann to the Academy of Sciences on a new galvanometer based upon the action of a magnetic field upon a movable current, and on the use of mercury to demonstrate this latter. We propose, in the present article, to give some supplementary details on this interesting apparatus, which is represented in figs. 1 and 2.

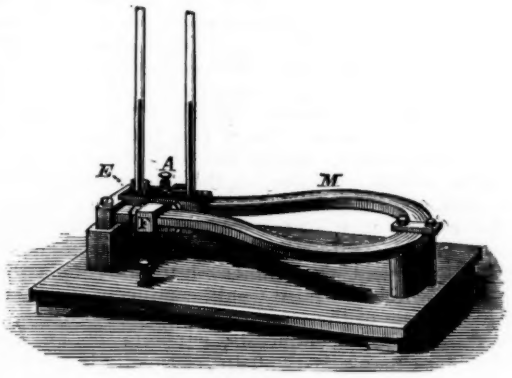


FIG. 1.

The two polar extremities of a powerful permanent magnet, M, are fitted into two pieces of soft iron, F. The exact form of these pieces is represented in fig. 2. Their internal surfaces (well insulated) are approximated to each other to a distance which does not exceed $\frac{1}{10}$th millimetre. This interpolar space, which is very thin, forms the middle portion of a manometer

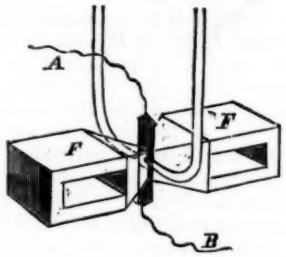


FIG. 2.

open in the shape of a U, the two branches of which are placed vertically. The current to be measured is introduced at the two extremities, A and B, communicating with two platinum plates which touch the surface of the mercury enclosed between the polar pieces.

* *La Lumière Electrique.*

The mercurial chamber is hermetically adjusted with the two limbs of the manometer, and this essential portion of the galvanometer is enclosed between two plates of ebonite, which protect the whole.

If we cause a current to pass through the stratum of mercury placed between the poles of the magnet, M, the mercury rises in one limb of the manometer and falls in the other, the difference of levels being proportional to the intensity of the current. The theory of this new galvanometer is very simple.

Suppose that we cause a current having the intensity I to pass through a parallelopiped of mercury placed in a magnetic field. Suppose that this layer of mercury enclosed between the poles communicates with the two manometer tubes by very small apertures which permit us to consider the liquid conductor as having a form strictly parallelopipedal. In these conditions the conductor will have a tendency to become displaced perpendicularly to the lines of the forces in a determined direction. But as the conductor is liquid, there will result a displacement of the mercury, which will rise in one of the tubes until the pressure resulting from the differences of the levels counterbalances the electro-magnetic pressure exerted in the opposite direction.

But as, in spite of the displacement of the mercury, there is no change in the form of the conductor, nor in its position in the magnetic field, the indications will be strictly proportional to I.

But to render the mercurial galvanometer practical it must be made sufficiently sensitive, and it is in the realisation of the conditions of the maximum sensitiveness that we see the essential part—the characteristic of the novelty of M. Lippmann's galvanometer. To render this instrument as sensitive as possible, it is necessary to find under what conditions as to construc-

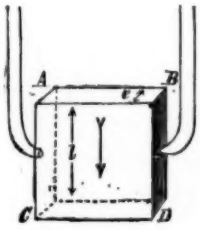


FIG. 3.

tion we may obtain the maximum of hydrostatic pressure, p, for a given current, I. Let A B C D (fig. 3), be the parallelopiped of mercury, the current traverses it in the direction of the arrow, and the lines of force are perpendicular to the surface, A B C D. Let l be the height of the parallelopiped and e its thickness in the direction of the lines of force. The force which tends to move the conductor perpendicularly to the lines of force is proportional to the intensity of the current, I, to the intensity of the magnetic-field, H, and to the length of the current, l. It is therefore proportional to I H l.

This force is exerted upon the surface of the parallelogram of which the height is l and the breadth e, the superficies consequently being $l\,e$. To obtain the pressure, p, per unit of surface, we must divide I H l by $l\,e$. The pressure, p, therefore $= \frac{\text{I H L}}{l\,e} = \frac{\text{I H}}{e}$.

This equation indicates at once the conditions to be observed to obtain the maximum pressure: 1, we must have a magnetic-field as intense as possible, which is effected by using a powerful magnet and by approximating the poles to each other as closely as possible, and 2, e ought to be taken as small as possible, which is also effected by the close approximation of the poles. This coincidence of the two conditions renders it possible to realise a galvanometer which is sufficiently sensitive for practical purposes.

It is evident that this galvanometer is aperiodic. The apparatus presented to the Academy of Sciences gave a difference in the level of the mercury equal to

63 millimetres per ampère. The figures 4 and 5 represent an electro-dynamometer based upon the same principle. The magnetic-field is formed by the same current, which before passing through the mercury traverses a solenoid, B (fig. 4), in the centre of

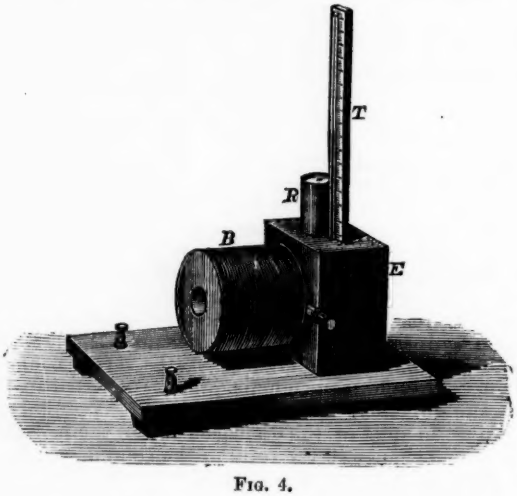


FIG. 4.

which is placed the stratum of mercury, L L. For one branch of the manometer there is substituted a reservoir, R, because in the electro-dynamometer the pressure is exerted only in one direction.

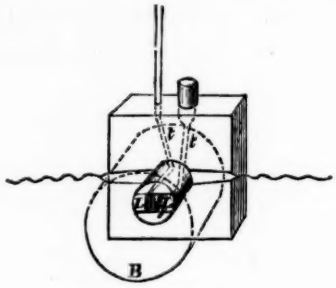


FIG. 5.

The plate of mercury is placed upon a core of ebonite which enters up to the centre of the solenoid, so the current is introduced by two plates of platinum, communicating with the two opposite sides of the layer of mercury.

Two conductors, shown by dotted lines and pierced into the mass of ebonite, place the layer of mercury in connection with the tube on the one side and with the reservoir on the other.

REVIEWS.

*The Maintenance and Repairs of Electric Conductors for all Practical Purposes.** By J. ZACHARIAS. Vienna, Pest, and Leipzig : A Hartleben.

The appearance of this volume will give our readers an insight into the extent and the thoroughness of the "Electrotechnical Library" (Elektrotechnische Bibliothek), which we owe to the enterprise of the Hartleben publishing firm. The volume before us is of a strictly practical character. The author describes the precautions which must be taken to keep electric conductors —whether telegraphic, telephonic, or subserving the electric light or the transfer of mechanical power—in a good working condition. Some of the points to which he calls attention may, at the first glance, seem trifling, but if neglected they may not only involve failure in the action of the entire installation, but even positive danger. The ordinary workman, intent solely on his task, and forgetting the nature of the agency with which he has to deal, is often tempted to lay hold with his hand of wires which should be touched only through the medium of some non-conducting implement.

The author discusses in succession the yearly inspection and repair of above-ground conductors, distinguishing those for telegraphic and telephonic purposes, and those for the arc light, &c., where stronger currents are required. He then passes to the periodical examination of underground or submerged conductors.

The next chapter is devoted to extraordinary repairs. The causes of damage to the posts and wires of telegraphic lines are more numerous than might be expected. Violent winds, especially if accompanied with snow, may overturn numbers of the posts, and entangle or break the wires. Ants, termites, and other insects, especially in tropical countries, bore into the wood, unless saturated with corrosive sublimate or coated with creosote oils. Woodpeckers, and birds of similar habits, bore into the posts in search of the insects; bears, in Norway and Russia, have been deceived by the humming sounds often given out, and have undermined the posts in search of a bees' nest; monkeys in India, South America, &c., think that the wires have been put up for them to swing upon, and often occasion damage; trees and bushes shoot out their branches in such a manner as to connect the wires with each other or with the ground; icicles not unfrequently perform the same ill-service. In public and frequented situations the ends of whip-lashes and kite-tails may occasion trouble. Hence there is room for constant watchfulness. Even the insulators require frequent inspection. In the neighbourhood of manufactories, railway stations, &c., they become coated with soot, dust, cobwebs, &c.

The author mentions, as a positive fact, that in private telegraphs in manufactories he has found the ends of a broken wire connected together by a piece of string, which of course would conduct or not according to the state of the weather.

For glow-light conductors, supports of an extra strength are naturally requisite, especially if the wires are packed in an insulating mass of tarred hemp, and enclosed in a leaden tube, as is often done in chemical works. Such conductors may often weigh 5 lbs. per yard, and must be treated accordingly. The following example may show the necessity of a perfect insulation for the glow-light :—"In a newly-built factory, where the walls were not yet dry the wires were well insulated, but not made water-proof,* and were laid in the plaster on the walls. As long as the electric light was used only by night for fitting up the machinery all went on well. But when regular work commenced the heat dried the walls, and their moisture evaporating, rendered the outer layer of the plaster damp again. The dynamo in consequence sparked at the brushes with loud detonations. The conducting wires were removed from the walls, and on examination the lime in contact with one of them was found impregnated with copper which had been galvanically deposited. The difficulty was overcome by rendering the conducting wires permanently dry.

The fourth chapter is devoted to the interruption of working in electric conductors, and the various methods for ascertaining the nature and the locality of the damage. Chapter V. treats of the examination of underground conductors, which, the author remarks, are out of the question for conveying strong currents.

An appendix contains a number of useful tables and a somewhat promiscuous assortment of very useful matter, such as the weights and resistances of copper wires, the reduction of the resistance of copper to 15° C, the calculation of wires for the glow-light, the influence of

* *Die Unterhaltung und Reparatur der elektrischen Leitungen für alle Zwecke der Praxis.*

* This appears to be somewhat paradoxical.—EDS. ELEC. REV.

temperature upon the conductivity of copper wire, the customary thickness of the cotton coating of wires, the specific resistance of the metals, the loss of tension in wires of 1 to 20 millimetres in thickness for currents of 5 to 90 ampères, and in wires of 6 to 60 millimetres for currents of 100 to 1,000 ampères.

Another chapter after the appendix discusses the management of dynamos. The directions given are, of course, not new to practical electricians; but when the electric light is introduced into manufacturing establishments it not unfrequently happens that the superintendence of the installation has to be committed to an engine-driver or mechanic not specially conversant with electricity. The author recommends that loose articles of iron, such as spanners, hammers, files, &c., must be kept at a respectful distance, since, especially in case of machines working at a high tension (300 — 600 volts) they may easily find their way into the moving parts, and occasion much damage. Metallic dust (from the friction of the brushes) is to be removed by means of a fine brush (*e.g.*, a soft painter's brush) or with the bellows. Care must be taken that no oil gets between the wires.

In a sequel we find returns on the influence of thunderstorms upon telegraphic arrangements. In the German Empire, 2,684 storms were registered for the year 1882, and occasioned 2,261 cases of damage. For 1883, the storms were fewer—2,064, and the cases of injury 2,046. In the former year there were 1,093 cases of injury to telegraph posts, 282 to the insulators, 30 wires were melted, 672 lightning conductors damaged, and 162 galvanoscopes, Morse apparatus, &c., were injured. These figures show a very small percentage. Thus, of the posts only 0·12 per cent. were damaged; of the insulators 0·001, &c. Twelve per cent. of the lightning conductors suffered, but as their object is to protect other parts of the plant from damage, they cannot be pronounced a failure. The underground wires escaped entirely.

This volume, like its predecessors, will prove an invaluable book of reference for electricians, and will prove of no small service to that increasing class who, without any special knowledge of electricity, have to make use of electric lights, &c., in their places of business.

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*Der Druck-Telegraph Hughes. Seine Behandlung und Bedienung. Speciell für Telegraphen-Beamte.** By J. SACK, Imperial Inspector of Telegraphs. Vienna, Pest and Leipsic: A. Hartleben.

The author commences his work with a brief exposition of the advantage of the printing telegraph as compared with systems in which the signs transmitted have to be translated into the ordinary character, thus giving scope for errors.

The first invention of a printing telegraph seems due to Vail, an American, who, according to the testimony of Morse, constructed an apparatus of this kind as far back as the spring of 1837. In 1841 Wheatstone put forward another device, which was tried on the line from Paris to Orleans.

Mr. Sack divides printing telegraphs into three classes—those in which the type-wheels move intermittently, as in an index apparatus; those in which the wheels move continuously, but are arrested for the moment whilst the impression of each letter is given; and those, lastly, where the type-wheel comes in contact with the paper without stopping.

The only two apparatus which have attained a permanent practical success are the "Motor Printing" of Phelps, and the Type Printer" of Hughes. Phelps's instrument belongs to the second class; it is described by American authorities as very efficient, but has the defect of not reproducing figures.

The third, according to the author, is unsurpassed for efficiency and correctness.

Passing over the history of this apparatus, which is specially recommended by the Convention of Telegraphists for correspondence between different countries, the author comes to its fundamental principle, which we need not here discuss.

He then considers in detail the electro-mechanical portion, or those parts of the apparatus which serve for giving and receiving messages; the mechanical portion which serves for connecting and disconnecting the printing arrangement and for the production of the impression; the apparatus for regulation; the electric portion, or the connections of the apparatus, the circuit, &c.; the regulating of the impression; the service, *i.e.*, the training of the officials and the method of using the apparatus, taking it down and cleaning it, and, lastly, the arrangements most in vogue for transmission. These various parts of the subject are fully discussed with the aid of 48 well-executed illustrations. The possible defects in the apparatus, and the methods for their detection, are given with great care.

As regards the officials employed, the author thinks that a careful training and much skill and knowledge are required. Without this precaution the peculiar advantages of the Hughes telegraph disappear, and its efficiency becomes inferior to that of the Morse.

* *The Hughes Printing Telegraph; its Use and Service; specially written for Telegraph Officials.*

NOTES.

Electric Lighting.—The *Dolphin*, four guns, Commander Eardley Wilmot, which was ordered to be ready for sea by the 18th instant, when she was to proceed to Suakim, was fitted with the electric light at Sheerness.

The *Times* trade report for Birmingham, of the 14th instant, stated that in the electric fitting branch there was a moderate amount of activity, chiefly for ship-lighting purposes.

An odd electric light installation has been brought out in America. The Bernstein Electric Light Company has fitted its system on a coasting sailing-vessel, using the steam power applied to the hoisting apparatus. About 50 lamps are in use, including signal lights in the rigging.

The Edison company is putting in a new and extensive plant for lighting the type-setting and press floors of the Government printing office, Washington.

The *Standard* one day last week devoted over a column to a leading article upon the subject of electric lighting, in the course of which it was remarked that the prospects of the Colchester undertaking, alluded to elsewhere in our present issue, are affected by the special nature of the plan adopted. This embodies a new mode of laying on the current, and, the article proceeds, there is much that has the appearance of economy and efficiency in the arrangements. The price to be charged is one half-penny per hour per lamp, which is only slightly in excess of gas at 3s. 9d. per 1,000 feet. Some hundreds of lamps are already in place, and should the Company have the good luck to get their plant into full work, they reckon upon reaping a substantial profit. So far the Gas Companies have some little reason to look with anxiety in the direction of Colchester, and the public may indulge in a hope that better days, or nights, are coming in respect to artificial illumination.

The electric light has made its appearance in the village of Luddenden Foot, at the works of Mr. James Clay, woollen manufacturer. One Crompton-Bürgin dynamo of the compound self-regulating type, and 36 Swan incandescent lamps of 20-candle power each are employed; the latter are placed in the carding-room, the spinning-room, part of the weaving department, &c. Mr. Wilson Hartnell, of Leeds, has carried out the work.

The whole of the premises of the Criterion Restaurant, Barrow, have been lighted throughout with incandescent lights of the Swan type, each light being of

20-candle power. The switch-board in the dynamo-room is fitted with one of Andersen's patent safety cut outs to prevent the possibility of any excess of current passing to the lamps. M'Whirter's patent ampère and volt meters are used, and as both read direct, without calculation, any intelligent workman can use them, and thus keep a check upon the working of the whole apparatus. The dynamo is known as the "Phœnix," and Messrs. Menzies and M'Whirter have the sole agency for this dynamo for Scotland and the North of England. The engine and boiler are by Robey, of Lincoln, and the whole of the material has been supplied and the installation carried out by Messrs. Menzies and M'Whirter, electric light engineers, Glasgow.

The London correspondent of a provincial paper says :—Lord Greville is a progressive peer. He is not only a Liberal, but a supporter of the electric light. He is asking even now whether any steps are about to be taken as to the lighting of the House with the electric light; also, having in view the great importance of obtaining the best and most economical results, whether Her Majesty's Government will ask the leading companies in Great Britain to tender for the same. The curious thing is that the House of Lords, in this summer weather, rarely sits until dark."

Why is the Holborn Viaduct now illuminated by means of gas?

One evening, a fortnight or so since, the Gülcher electric lamps at the Crystal Palace were used for the first time without the precaution of having the gas alight. The result, we are informed, was very unfortunate, as during the evening the whole of the lights went out, leaving the Palace in darkness until the gas could be brought into requisition. We should be glad to believe that our information was incorrect.

Electric Lighting at Plymouth.—The opening of the new promenade pier at Plymouth took place on Thursday, the 29th May, in the presence of a large company. This is the first pier on which the electric light has been used throughout. The deck of the pier is lighted by 18 Brush arc lamps, inclosed in hexagonal lanterns, glazed with ribbed glass, which, while toning down the glare, materially aids the diffusion of the light. The refreshment-rooms, reading-rooms, and book-stall, are lighted by 32 incandescent lamps, run in groups of eight on the arc circuit. Two No. 6 Brush dynamos furnish the current, each machine supplying nine arc lamps, and 16 incandescent lamps. The power is supplied by a 16-horse power Otto gas-engine, placed under the head of the pier. The effect on Thursday, when the lamps were turned on, was magnificent, the whole pier being flooded with a soft white light, which illuminated a considerable portion of the Hoe, upon which thousands of people had congregated. The pier itself was crowded to its utmost capacity, over 14,000 paying for admission. The work was carried out for the Great Western Electric Light and Power Company by Mr. J. Woolley, the superintendent of their Bristol lighting station. Messrs. Callender supplied the cable, and Messrs. Verity the electroliers.

The Post Office and the Telephone.—In the House of Commons on Thursday, the 7th inst., Mr. Whitley asked the Postmaster-General whether he was aware that the Post Office had refused to allow the same advantages of telephonic inter-communication to Liverpool and Birkenhead, which are divided by the River Mersey, as are allowed to Manchester and Salford, which are divided by the River Irwell; and whether he was prepared to reconsider the application of the Lancashire and Cheshire Telephonic Company to establish communication betweeen the two licensed areas, so as to give to the people of Liverpool and Birkenhead the facilities which are enjoyed by Manchester and Salford. Mr. Fawcett was understood to say that Salford and Manchester were served as one town for postal and telephonic purposes. The same connection did not exist between Liverpool and Birkenhead which had each a separate telephonic and postal system. He regretted, therefore, that he could not accede to the request of the hon. member, but he thought that telephonic communication between Liverpool and Birkenhead should be by trunk wire, the same as between Liverpool and other towns; this would, no doubt, be more expensive. Mr. Briggs asked the Postmaster-General whether he was aware that the Lancashire and Cheshire Telephone Company were desirous to open call offices in the various towns in their district, whereby for a small payment the public might converse with subscribers to the Telephone Exchange; whether he was aware of the existence of such accommodation in cities of the Continents of Europe and America, where the telephone was in use; whether the Postmaster-General insisted upon the Lancashire and Cheshire Telephone Company charging 1s. each time such facility was afforded, and whether he could see his way to so relax these terms as to enable the company to afford the public the great convenience referred to. Mr. Fawcett: The subject of this question has been for some time under careful consideration, and I regret that I am unable to sanction any smaller charge being made to the public for speaking in the manner proposed by the Lancashire and Cheshire Telephonic Exchange Company than 1s., the *minimum* amount now charged for an inland telegraph message. Mr. Jacob Bright asked the Postmaster-General whether by letter dated April 18, 1883, addressed to the Lancashire and Cheshire Telephone Company, the Post Office consented to erect and maintain wires for telephonic communication between town and town for a guaranteed payment of £10 per mile per annum; and if, in such letter, the company were to be allowed to obtain as many subscribers as they could for each wire, and to charge whatever annual rate they chose, so long as no favour or preference was shown—that is to say, so long as precisely the same rate was charged to every subscriber for the same use of a wire; whether, when the company accepted the conditions and announced their intention of bearing the entire cost themselves and giving the advantages to the subscribers, free of charge, the department refused its assent to such an arrangement, and ultimately insisted upon the company charging a *minimum* annual rental of 10s. per mile of distance between town and town, or, if the subscription was monthly, a *minimum* charge of 18s. per mile per annum; whether he was aware that, in the opinion of the company, these rates were practically prohibitive, and whether he would consider the advisability of so modifying them as to give to the people of Lancashire and Cheshire the advantages which the company are ready and willing to offer them, of being able to converse between town and town of the district on reasonable terms. Mr. Fawcett offered to show the correspondence which had taken place between the Lancashire and Cheshire Telephone Company and the Post Office to any member who might be interested in the subject. Although most desirous that every facility should be afforded for telephonic communications, he did not think he was justified, with due regard to the interests of the public and the revenue, in making any modification in the terms to which the department had agreed with regard to trunk wires.

An admirable article upon the present position of the Post Office in regard to the telephone system, appeared in the *Times* one day last week, and from it we make the following extracts. Alluding to the decision of Mr. Baron Pollock and Mr. Justice Stephen, in December, 1880, allowing the claim of the Post Office to a monopoly of telephonic communication, it proceeds :—"Until Parliament had pronounced upon the question the Post Office should have held its newly-ascertained rights in strict abeyance, and should only have claimed from the telephone companies such nominal royalties as might serve the purposes of a formal acknowledgment. To act in any other way was to convert an accidental wrong into a deliberate one, so as not only unfairly to deprive meritorious inventors of

rewards which they had earned, but also to deprive the public of conveniences and advantages to which they were entitled, and for which, on any reasonable scale, they were willing and anxious to pay. It has clearly been the fear of the officials of the Post Office, from the first, that any great increase in the use of the telephone would be at the expense of the telegraph, and that it would serve, by diminishing the receipts of that department, to direct attention once more to the improvidence of the bargain by which the telegraphs were taken over by the nation. That bargain, as is well known, was the pet scheme of some of the permanent officers of the department, and in their eagerness to bring it to a conclusion they were able to induce their chiefs to assent to terms which would scarcely bear impartial investigation. All credit must be given to Mr. Fawcett for his earnest desire to promote in every way the welfare of the department and the convenience of the public, but he is necessarily greatly at the mercy of his staff, and probably knows, about many matters, only just as much as they choose to impart to him. It is much to be wished that Parliament could find time to liberate the telephone from the bonds of red tape in which it is being strangled, and to allow its future to be shaped by the operation of the ordinary laws of political economy. In the meanwhile, and even when this desirable release has been effected, it will be prudent not to lose sight of the moral of the story. This is, if anything, that the practical applications of science cannot be safely or prosperously committed to the hands of a Government framed upon the model of our own."

In reply to Mr. Houldsworth, in the House of Commons, on Monday, Mr. Fawcett said it was lately found that a system prevailed in Manchester whereby racing news telegraphed at Press rates to certain clubs was retransmitted by telephone to various other clubs and persons. This was considered to be an abuse of the privilege by which news is telegraphed at a much lower rate than is charged for ordinary telegraphic messages, and steps were accordingly taken. No distinction was made in the treatment of different clubs.

In answer to Mr. Houldsworth again, on Tuesday evening, Mr. Fawcett said news was supplied at Press rates to clubs registered at the General Post Office, on condition that such news was used solely for exhibition in the club rooms. The systematic communication of such news to persons other than members of the club, whether the communication was by telephones or otherwise, was held by the department to be an abuse of the privilege.

The *Manchester Courier*, alluding to the case of a local club which led to the above inquiries by Mr. Houldsworth, in its issue of Monday last, said :—"The Post Office has a monopoly of the telegraphic system of communication, but is that any reason why they should prevent the development of a system of which they are not the owners? If the postal authorities find that the newer system of communication is likely to supersede that which belongs to them, their better plan will be not to interfere with it in such a way as to cripple the public convenience, but to make such an arrangement as will promote it either by absorbing the telephonic companies, or by adopting the principle of free trade in the matter. . . . . The postal authorities refuse to permit the clubs to be supplied with telegraphic news at Press rates until they have not only ceased their connection with the telephone system, but they also give an undertaking that no members of the club have telephones in cottages or houses in the neighbourhood. We are not quite sure that these conditions have been applied to every club, but they have to the Ellesmere and some others."

The *Western Morning News* claims that Plymouth and Devonport are, in the matter of telephonic facilities, especially the victims of the Postmaster-General, and says that the public interests of the country are being seriously damaged because Mr. Fawcett, acting at the instigation of some of the permanent officials of the department, is practically crushing and stifling the use of one of the greatest inventions of modern times, the telephone. It would be bad enough if the postal telegraph revenues would really be injured by the development of the telephone, but the fact is that, while depriving the public of vast advantages, the Post Office is not benefitting its own revenue to any appreciable degree, and is thwarting the practical application of a scientific invention which would result in a great increase to the telegraph revenue itself.

Telephony in Philadelphia.—The correspondent in Philadelphia of the New York *Electrician* says the Clay Commercial Telephone Company is actively engaged in running wires throughout the city, notwithstanding that the American Bell Telephone Company and the Bell Telephone Company of Philadelphia, threaten suit for infringement.

The Bell Telephone Company.—The Pittsburg *Commercial Gazette* is authority for the statement that the Bell Telephone Company offered the Western Union Telegraph Company $10,000 to discontinue the use of the Gray duplex between Pittsburg and the West on account of its annoyance to telephone subscribers.

The Telephone in Trinidad.—Mr. A. W. Gray, manager of the Tropical American Telephone Company, which has established exchanges in Trinidad and Barbados, has paid a flying visit to Trinidad; not, however, in connection with the threatened action by his company against the local Government for the alleged infringement of the Bell Telephone patent rights. It is understood that the action, though still in abeyance, is ultimately to be proceeded with. According to Mr. Gray, the Telephone Exchange in Port of Spain has now upwards of 130 subscribers, and it has been arranged to open a large line between San Fernando and the capital. Notwithstanding its limited population, about 20 subscribers have already been obtained for the branch exchange it is proposed to open in San Fernando, and from 30 to 40 estates in the colony have intimated their readiness to enter the system as soon as the lines can be extended to permit of their doing so.

The British and Foreign Telephone Company, Limited.—We have received a circular to the effect that the British and Foreign Telephone Company, Limited, is prepared to supply telephone transmitters and telephone receivers, made under Boult's patent, No. 3271, A.D. 1883, free from infringement of any other patent. The telephone receiver is an improvement on the "Glasgow" receiver, and like it, has a metallic disc *tilted up*, and not "held down all round its edge." The current regulator of the transmitter is an entirely new form of Hughes's carbon pencil microphone, the improvement consisting in dispensing with a diaphragm and tympan, and in placing a turbine wheel on the carbon pencil. Mr. Justice Fry decided, states the circular, that "the true meaning of the claim in Edison's patent is the union of a tympan or diaphragm capable of vibrating under sound waves, with a tension regulator, and that Edison described the essential requisite of his invention to be the combination of a vibrating diaphragm and a tension regulator." Boult's current regulator has no diaphragm or tympan, or any equivalent thereof, and, therefore, is entirely free from Edison's, Blake's, or any other patent. Mr. G. W. Hemming, Q.C., gives as his opinion that "the 'Boult' transmitter is not an infringement of the 'Edison' transmitter patents," and also that on the construction which has been judicially put upon the "Bell" patent, the "Boult" receiver is not an infringement.

The Laying of the Bennett-Mackay Cable.—In the New York *Evening Post*, of the 22nd ult., is published an article descriptive of the arrival of the s.s. *Faraday* at Rockport, and of the landing of the shore end of the Bennett-Mackay cable.

Telegraphy.—Telegraphic communication is in course of construction between Merv and Askabad.

The Khartoum Expedition.—A light overhead telegraph line is to be erected parallel with the proposed railway from Suakin to Berber.

Submarine Cables Convention.—In the Senate at Paris, on Wednesday, the International Convention for the protection of submarine cables was adopted.

The s.s. "Dacia."—This cable ship belonging to the India Rubber and Gutta Percha Company, arrived at Pernambuco on the 12th inst. All well.

Cheap Telegrams.—The Oldham Chamber of Commerce, in response to a communication from the London Chamber of Commerce, has decided to support the proposal for a reduction in the present charge for postal telegrams.

Sixpenny Telegrams in Australia.—It is understood that Mr. W. J. Trickett, the Postmaster-General of New South Wales, is about to recommend to the executive that a sixpenny telegraph rate be extended to all the places enjoying the penny postage.

Duplexing the Mackay-Bennett Atlantic Cables.—At the Royal Society's conversazione, on the 11th inst., a very interesting exhibit was made by Messrs. Latimer Clark, Muirhead & Co., Limited, of the electrical apparatus manufactured by them for the Mackay-Bennett Atlantic cables, consisting of Muirhead's condensers and inductive resistances, exhibited in operation to illustrate the Muirhead system of duplex telegraphy as applied to submarine cables. An artificial submarine cable was formed of Muirhead's inductive resistances, working duplex with Sir William Thomson's syphon recorders, one at each end of the line, and of the same electrical dimensions as the cable now being laid by the s.s. *Faraday*. The artificial cable has the same ratio of resistance to capacity throughout its entire length as the real cable, of which it is an electrical facsimile. The total capacity of the apparatus employed in this exhibit was 2,220 microfarads, equal to that of about 6,700 knots of submarine telegraph cable. Such a display of apparatus is specially interesting, representing as it does the fruits of much labour and experience, and a large outlay of capital. Those engaged in submarine telegraph work can appreciate the practical advantages of such a system as that which practically doubles the carrying capacity of the cable.

House-to-House Electric Lighting.—The *Leeds Mercury*, in an article having reference to the experiment at Colchester, says :—"The fact that electric lighting for domestic purposes still remains a luxury of the rich is due, no doubt, to the difficulty and cost of installing a satisfactory system of house-to-house illumination. Wherever there is gas, houses have been fitted with a view to lighting by gas, and neither owners nor occupiers are disposed to sacrifice the cost incurred for the purpose of substituting the, as yet, more costly and more uncertain mode of lighting by electricity. And yet there is a general feeling of regret that some practical system of house-to-house lighting by electricity has not been introduced in all our large towns. Those whose wealth has enabled them to introduce the electric light into their houses, and those who have been privileged to see a really successful installation of electric lighting in public buildings, know that there is no comparison between this mode of lighting and lighting by gas. As regards illuminating power, purity, coolness, and steadiness of light, the advantages are all in favour of the incandescent electric lamp." Having mentioned the Colchester installation, the *Mercury* continues :—"The experiment is one which will be watched with deep interest throughout the country, and should it be a permanent success it may prepare the way for a more general introduction of electric lighting in private houses."

Electric Fire Alarm Bells.—Last week a trial was made at Kidderminster of the electric call bells which have lately been introduced for the use of the volunteer fire brigade. Nine bells had been provided, and on a glass disc being broken outside the fire station in Market Street, an electric circuit is completed, and the whole of the bells set ringing. All the members of the brigade are not communicated with in this way, but it is intended that those who receive the alarm shall send messages to the others. On a given signal by Capt. H. Turney, the glass disc was broken, and the firemen who reside nearest the station were soon on the spot. The first arrived in 15 seconds, the next in 30 seconds, and two more five seconds after. It was reported that a fire raged at Pedmore, and the first member of the brigade at once rang the electric bell to the stables in New Street. The steam fire engine was got out, the horses attached, and a start made for the scene of the supposed fire in 4½ minutes. In the case of an actual fire recently, the brigade was trotting past the town clock four minutes after the alarm was given.

The School of Telegraphy and Electrical Engineering.—Recently, Mr. H. R. Kempe conducted an examination of the pupils of this college. The questions set, together with the marks awarded and the examiner's reports, have been laid before us (*Knowledge*), and most certainly show a state of things creditable alike to the school and its pupils. It appears that the system pursued is to place every new entrant into the elementary portion of the school, where his progress is checked day by day. If he fails to satisfy the tutors in this division, he is refused admittance to the advanced section, where the only thing he could do would be to impede the progress of the others. It is, however, a noteworthy fact that only the absolute dullards or positive idlers stay long in the lower class, and it is every teacher's experience that such troublesome pupils find their way into every educational establishment. The field traversed in the elementary section is a considerable one, and embraces the fundamental principles of telegraphy, telephony, electrical measurements, &c.; while the advanced class occupies itself with cable testing, the construction and principles of dynamos, motors, lamps, secondary batteries, &c., and the more advanced systems of electrical measurement. The syllabus is thus a very comprehensive one, and upon it Mr. Kempe based his questions. We will quote one taken at random from each paper :—Elementary : "Two batteries, A and B, are joined in circuit with a tangent galvanometer and a resistance, x. When the two batteries assist one another, a deflection of D° is obtained ; but when the batteries oppose one another, a deflection of $d°$ is obtained. Battery B is now removed, and the resistance, x, is altered first to R, so that the deflection $d°$ is reproduced, and then to r, so that the deflection D° is reproduced. Find the value of x in terms of R and r. The two internal resistances and the resistance of the galvanometer to be neglected." Advanced : "How would you determine the current and difference of potential between the terminals of an electric lamp worked by alternating currents, the resistance of the lamp being unknown ?" Mr. Kempe, reporting on the answers of the advanced pupils, says, "I must congratulate you on the most satisfactory replies which have, with few exceptions, been given to the various questions. The result is a highly creditable one to the school, and shows that the course of instruction is very complete." Speaking later of the elementary class, the examiner says :—"I must again express my satisfaction at the general excellence of the replies to the questions, and the credit which they reflect upon the school." The school, says our contemporary, is in every sense of the word commendable, as the results accomplished are the outcome of private enterprise.

The Farringdon Blowing Lamp.—Messrs. Pontifex and Wood, of Farringdon Works, Shoe Lane, E.C., have patented a new form of blowing lamp for blowing joints, burning off paint, and loosening metallic joints when set with corrosion, which will be found invaluable for many purposes where heat is required, and an adjunct that will be appreciated in the workshop, as it is very light, and can be used in any position, often where no other tool could be placed. It consists of a cylinder with two pipes, one telescoped over the other; one of which is attached to the top of the cylinder, and has a very fine jet formed upon its upper end. The other and longer tube, which slips closely over the fixed pipe, has two lateral openings, through which a proper admixture of air with the gas takes place, so as to obtain a pure blue flame, and around the bottom end of this pipe a small saucer is placed containing methylated spirit for starting the flame.

Technical Education.—The additional amount of money—some £30,000—required for the completion of the Technical College at South Kensington, for which the Prince of Wales made an appeal through the newspapers a short time ago, is now guaranteed, and all necessary arrangements for opening the college will probably be carried out in time for an inaugural winter session.

Awards at the Calcutta Exhibition.—We are indebted to the *Colonies and India* for the following awards at the Calcutta Exhibition. The date expected for the publication of the official list is long since past, and a correspondent says "it is impossible to say when it will be issued." The list given by the journal above mentioned is the fullest and most complete yet obtainable, and from it we extract the following:—Gold medals and first-class certificates: Consolidated Telephone Construction and Maintenance Company, Limited, London, electrical communication between trains; Telegraph Construction and Maintenance Company, Limited, London, telegraph cable; George Angus and Co., Liverpool, India-rubber belting. Silver medals and first-class certificates: Gilkes, Gilbert & Co., Kendal, electrical turbine; Rylands Brothers, Warrington, iron telegraph wire. Bronze medals and second-class certificates: Doulton & Co., Lambeth, telegraph pipes; Paterson & Cooper, London, electric bells.

Overhead Wires.—Last week the appeal of the United Telephone Company against the decision of Mr. Justice Stephen, in regard to overhead wires, came before the Master of the Rolls and Lords Justices Bowen and Fry. Mr. Justice Stephen, sitting without a jury, granted an injunction, at the instance of the Wandsworth Board of Works, to restrain the defendants from stretching a telephone wire across the Putney Road, on the ground that the plaintiffs, as the street authority, had a discretionary right of giving their consent to such a proceeding. The plaintiffs based their case on three distinct grounds:—1st. They concluded that the defendants were a company subject to the provisions of the Telegraph Act, 1863, and were, as such, forbidden to place a telegraph wire over, or along, or across a street or public road, except with the consent of the body having the control of it. 2nd. They submitted that, as the owners of the soil of the street, they had an absolute right to prevent the defendants from suspending wires over their road, upon the principle that the air above the road was as much theirs as the road itself. 3rd. The plaintiffs said that the overhead wire was in fact a nuisance to the road, and exposed persons walking along it to the greatest danger. The learned Judge decided that the defendants were not a company within the terms of the Act of 1863, that the wire was not in such a condition as to be a nuisance or a source of danger to the public, but that the plaintiffs had a discretionary right to prevent the erection of such a wire. He therefore gave judgment in favour of the plaintiffs, with costs, but suspended the injunction until after the present appeal had been heard and decided. The Master of the Rolls said the wires in question were affixed to chimneys of houses above the roofs on either side of the street, about 30 feet above it. The question involved the construction which was to be placed on the Act which gave powers to the local board to control and manage the streets. Had the wires been a nuisance, or had they been dangerous to persons using the streets, undoubtedly the board would have had a right to an injunction; but, in this case, it was proved that they were no nuisance, and that the danger from them was inappreciable. The question, then, was whether the board had such a right of property, not only in the street, but the air above it, that they were entitled to an injunction against the company, notwithstanding there was no injury to the property. In his opinion, the right of the Board of Works was limited to the area of ordinary user for the purposes of the street, and the wires in question being above the area, the board had no right to an injunction against the company. The decision of Mr. Justice Stephen, granting the injunction, must therefore be reversed. The other learned Judges having concurred, the decision of the Court below was reversed.

Kelway Electric Log Syndicate, Limited.—Upon the petition of E. Gilbert, a creditor, an order was made by Mr. Justice Kay, on Friday, the 13th inst., continuing the voluntary liquidation of this company under the supervision of the Court.

Revenue.—The telegraphic service yielded £355,000 in the period from 1st April to 14th June of the present year against £350,000 last year.

The Longitude of the Canary Islands.—We understand that a Spanish Commission, consisting of Sr. Dn. Miguel Garcia Villar, captain in the Spanish navy, and Sr. Dn. Manuel Roldau, have arrived at Santa Cruz de Teneriffe, with the object of determining the longitude of the Canary Islands, and that they have fixed their instruments in Fort San Pedro, at the commencement of the Marina. The overhead line from the Observatory at San Fernando is to be joined in Cadiz to the cable, from Cadiz to Teneriffe, which has been placed at their disposal by the Spanish National Telegraph Company during the night-time. At Teneriffe, the cable will be joined at the hut to the overhead line which passes Fort San Pedro, where this line will be tapped for their experiments.

The Invention of Dynamo-Electric Machines.—The invention of dynamo-electric machines has been largely discussed for some time. Some electricians, says the *Bulletin de la Compagnie Internationale des Telephones*, jealous of the incontestable success of the Gramme machine have endeavoured to find predecessors and have striven to diminish its merits. They have opposed to it the Pacinotti ring, the superiority of which Prof. Silvanus Thompson has lately claimed to have established. We have not to refute such opinions; the following despatch, addressed from Turin this week to M. Gramme, decides the question absolutely:— "Gramme, 15, Rue Drouot, Paris.—The judges and organisers of the Turin Electrical Exhibition, assembled in banquet, salute Monsieur Gramme, the first inventor of industrial dynamo machines." Even the compatriots of Pacinotti recognise in M. Gramme the inventor of the industrial machines; this is, in our opinion, the best proof that the latter could claim, and we join heartily in the homage of the electricians of Turin.

Social Gathering of Old Telegraphists.—A very interesting *reunion* takes place annually at the Salisbury Hotel, Fleet Street, when the principal officers of the companies that became defunct with the transfer of the telegraphs to the State renew old friendships by dining together once a year. Forty was originally the number meeting in this way, but only thirty now remain, and of these advancing years prevent several from attending. The day usually observed has

been the Queen's birthday, but that date being inconvenient this year, the gathering took place on Wednesday last, when Mr. Graves presided over a small company composed of Sir Charles Bright, Mr. Edward Bright, Mr. G. G. Newman, Mr. C. E. Spagnoletti, Mr. H. Sache, Mr. J. Walsh, Mr. Eaton, Mr. A. H. Radcliffe, Mr. C. V. Boyes, and Mr. C. H. Patey, the last-named being the guest of the others. The proceedings were of a purely social character, and passed off most pleasantly. Mr. J. Walsh was appointed president for the next gathering; Mr. G. G. Newman having acted in that capacity for the previous year.

NEW COMPANY REGISTERED.

Blanch Brain Brothers, Limited.—Capital £10,000 in £2 shares. Registered office, 33, Chancery Lane. Objects: To carry on the business of mining and electrical engineers in all branches. Signatories (with one share each): John Darlington, M.E., 1, Coleman Street Buildings; J. G. Wood, 7, New Square, Lincoln's Inn; O. Reichenbach, C.E., 6, Victoria Street, S.W.; R. G. Elmes, C.E., 7, Westminster Chambers; C. M. Owen, 6, Westminster Chambers; W. Blanch Brain, Cinderford, Gloucestershire; C. N. Haxell, Kingsbury. Registered 14th inst., without articles of association, by Faithfull and Owen, 6, Westminster Chambers, Victoria Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Midland Electric Light and Power Company, Limited.—The annual return of this company, made up to the 23rd ult., was filed on 10th inst. The nominal capital is £50,000 in £10 shares. Seven shares have been issued and are fully paid, the paid up capital showing an increase of £40 as compared with the previous return. Registered office, 33, Waterloo Street, Birmingham.

Hastings and St. Leonards-on-Sea Electric Light Company, Limited.—The annual return of this company, made up to the 13th inst., was filed on the 14th inst. The nominal capital is £500,000 in £10 shares. 850 shares have been taken up, and upon 683 the full amount has been called, the remaining 167 shares having been issued to the Hammond Electric Light and Power Supply Company, Limited, as fully paid. The calls paid amount to £6,657 10s., leaving £172 10s. unpaid. As compared with the previous return, the paid-up capital shows an increase of £178 15s. Registered office, 63, Cambridge Road, Hastings.

Hygienic and Electric Association, Limited.—At an extraordinary general meeting of this company, held at 285, Lake Road, Landport, Hants, on the 7th inst., it was stated that the company, by reason of its liabilities, could not continue its business, and it was therefore resolved to wind up voluntarily, Mr. Richard Henry Viggers, of Portsmouth, accountant, being appointed liquidator.

CITY NOTES, REPORTS, MEETINGS, &c.

Faure Electric Accumulator Company, Limited,

AN extraordinary general meeting of the shareholders of this company was held at the Cannon Street Hotel, on Thursday afternoon, Mr. Harcourt Turner presiding. The notice convening the meeting stated that it was for the purpose of appointing directors to carry on the business of the company, and to consider a resolution for voluntary winding up.

The Chairman said it was thought advisable by the committee of inquiry, seeing that a question was likely to arise as to the validity of some of the contracts, and that it might be necessary to take steps against M. Philippart, to ask their solicitors, Messrs. Campbell & Co., to relinquish their office, and to appoint successors. Messrs. Campbell & Co. had been concerned in drawing up most of the contracts, and they felt they could not ask them, in the proceedings against M. Philippart, to take their side, and, so to speak, blow hot and cold at the same time; and so, after anxious consideration, Messrs. Snell and Greenip were appointed in their stead. Claims had been made upon the company, which there was no money to meet, and in order to avoid the necessity of calling a meeting, and making public their affairs, the committee made the payments themselves. They had not to look very far into the affairs of the company before they found that M. Philippart was a very great debtor to the company. They at once wrote to the syndic in Paris who had charge of his bankruptcy affairs, informing him of what claims they had. After doing this, they placed their affairs in the hands of an *avoué*, who informed them that they must at once appoint some one to be in a position to represent the company. This was one reason why the committee presented the petition for winding up compulsorily. Another reason was, that they had received letters from different creditors which left no doubt in their minds that if the committee had not presented a petition others would have done so, and then the liquidation would have got into hands which he should be sorry to see it in. They felt the only course for them was to present a petition for compulsory liquidation, and get a provisional liquidator appointed, who would be in a position to carry on the business; they would then have breathing time, and be enabled to place the state of affairs before the shareholders and take their opinion as to whether they should go on with the petition for compulsory liquidation, or have a voluntary one.

Mr. Norris asked the reason for going into liquidation at all, and thought directors should have been appointed to act in the first place, to ascertain as to the value of their patent without the unpleasantness and expense of going into liquidation.

Mr. Solomon said it was not an easy matter to appoint directors at once, and the committee thought it desirable to obtain protection. It was further stated that for the last eighteen months, or two years the company had ceased business, the whole of the interest being in the shares of the French Electrical Storage Company, so that there was nothing to do but to divide those shares and wind up.

Mr. Hoffgaard said the original directors, when they knew of the bad name M. Philippart had achieved, should have called the shareholders together before allotting to him 20,000 shares.

Sir Charles Clifford said the original directors did not allot 20,000 shares to M. Philippart; they were applied to in the ordinary way by a member of the Stock Exchange for 20,000 shares, but he believed they were afterwards sold to M. Philippart, who was, without their knowledge, doing his utmost, by purchasing from others as well, to obtain that influence which afterwards caused the other directors to come before the shareholders and tell them that they could no longer act. The shareholders elected to take the course proposed by M. Philippart, and the directors resigned.

After some further discussion,

Mr. L. A. Solomon moved the appointment of Messrs. Harcourt Turner, Edward Ponsonby, and William D'Oyly, as directors, to act formally until the liquidation was entered upon.

Mr. Norris seconded the motion, which was agreed to, a sum of eighty guineas being afterwards voted for their remuneration, it being understood, however, that that amount would be distributed amongst the members of the committee.

The Chairman moved "that the directors be empowered to take such steps as they may think necessary to wind up this company voluntarily," which was seconded by Mr. Tucker, and carried unanimously. A cordial vote of thanks to the chairman then terminated the meeting.

Jablochkoff Electric Light and Power Company, Limited.

A MEETING, convened by the liquidator, was held at the offices of the company on the afternoon of the 29th ult., when there were about 40 shareholders and creditors present.

According to the statement submitted by the liquidator, the position of affairs at the time of the resolution for liquidation being passed, February 1st last, was:—Liabilities: Secured creditors, £3,950; preferential creditors, £506; unsecured creditors, £11,222; shareholders' capital, £105,000. Assets: Debtors, 2,000; calls (valued at), £,2000; plant, &c., £23,752; patents and goodwill, £156,000. The liquidator had been carrying on the business, and had advanced £1,000 for the purpose; but all schemes for reconstruction of the company appeared to have fallen through. Certain proposals, however, had been made to the liquidator by possible purchasers of the company's works and assets, and the meeting nominated a committee to consult with the liquidator as to the sale and realisation, the result of their deliberations to be communicated to the general body of shareholders and creditors, The committee was composed of the directors, *ex officio;* Messrs. Gaudet, Ainsleigh and Steinthal, shareholders; and Messrs. Hewlett, Hough, and Callender, creditors.

Direct United States Cable Company, Limited, of 1873 (in Liquidation).

A MEETING convened by the liquidators (Messrs. Dever and Griffiths) was held at the offices of the latter, 4, Lothbury, on Tuesday, at which Mr. Griffiths presided.

The notice convening the meeting having been read,

The Chairman said the total amount of assets realised by the sale of cables, land, houses, &c., to the new company was £1,360,020 12s. 1d., in respect of which there had been distributed amongst the shareholders, in shares in the new company,

£1,214,200. The debts and liabilities of the company had been paid, and the total costs, including those of the very important arbitration in which they were concerned, amounting to £10,344 11s. 11d. A cash dividend of 3s. 8d. per share had been paid, and this accounted for the whole of the assets. Alluding to the delay which had occurred in winding-up, proceedings having commenced in 1877, the Chairman said they had had some difficulty in finding certain persons who were trustees for the company, and who had to execute deeds to enable them to effect a transfer to the new company; this process had only just been completed, and the meeting was called immediately. He further stated that the costs of the arbitration case had been reduced by taxation to about one-fifth of the expenses actually incurred by the other side. He concluded by moving that the accounts submitted by the liquidators be approved and adopted, and that the company be dissolved.

This was seconded and carried unanimously, whereupon a vote of thanks was passed to Mr. Griffiths for the economical manner in which the winding-up had been conducted, and Mr. Griffiths, in replying, remarked that had the company been wound up under the court, it would have cost something like twenty times as much on the most moderate calculation.

The proceedings then terminated.

The Electrical Association, Limited.—This association has resolved upon a voluntary winding-up, and Mr. F. A. Ford, of Hatton Court, Threadneedle Street, E.C., secretary, has been appointed liquidator. The resolution was confirmed on the 13th inst., and duly filed on the 16th inst.

South Eastern (Brush) Electric Light and Power Company, Limited and Reduced.—A petition for confirmation of the resolution, reducing the capital from £100,000 to £51,000, has been presented to the Court.

Great Northern Telegraph Company, Limited.—Messrs. C. I. Hambro & Son will pay, on the 1st of July, a half-yearly interim dividend at the rate of 5 per cent. per annum on the shares of this company.

Maxim-Weston Electric Company, Limited.—Vice-Chancellor Bacon on Saturday confirmed the resolution of this company to reduce the capital from £500,000 to £250,000.

Indian and Oriental Electrical Storage and Works Company, Limited.—A resolution passed by this company to reduce its capital was duly confirmed by the Court on Saturday.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th June, are £2,995 as compared with £2,531 in the corresponding period of 1883.

PROCEEDINGS OF SOCIETIES.

Physical Society, June 14th.

Dr. GUTHRIE, President, in the Chair. New member: Mr. Stanley Butler.

MR. HOFFART read a paper on A New Apparatus for Colour Synthesis, which he exhibited. The colours are obtained by sending through prisms the light from a series of platinum wires made incandescent by Grove or other cells. Three different rays can be compared or superposed at a time by the instrument shown. The rays are received into the eye through an adjustible eye-piece; and various ingenious devices are adopted in the construction of the apparatus. The intensities of the lights are regulated by rheostats in the circuits of the platinum electro-pyres. Lord Rayleigh, Mr. Stanley, and Prof. Perry commented on the apparatus; and Dr. Guthrie thought that it would be useful in studying colour blindness.

Mr. BLACKLEY read a paper on "The Velocity of Sound in Small Tubes," a continuation of experiments formerly brought before the Society by the author. Mr. Blackley showed experimentally how his measurements were made. He found that pipes in which the upper proper tones were in harmonic order, or, better still, those in which they were far removed from the harmonic order and therefore dissonant, were best for the purpose. He had obtained velocities from fine tubes varying from 11·4 to 88·2 millimetres in diameter, the former giving 324·38, the latter 330·13 metres per second as the velocity of sound. In free air Mr. Blackley thought the velocity would come out 331 metres per second. The differences of velocity for the different pipes were very regular. Lord Rayleigh, Dr. Stone, and Dr. Guthrie made some observations on the paper, Dr. Stone remarking that the diameter of a pipe modified the pitch of the same rate, a fact noticed in musical instruments. In experiments on water-waves Dr. Guthrie had found that in rectangular troughs the rate of oscillation was less than in circular ones.

Mr. HOWARD read a paper by himself and Mr. Hayward on "The Thermal Relationship between Water and certain Salts, such as Sulpho-ethylate, &c." Curves of results were given and interpreted.

NEW PATENTS—1884.

8861. "Electrical indicating apparatus for use in transmitting instructions on board ship, &c." R. L. SPICER. (Communicated by E. W. Lloyd.) Dated June 11.

8865. "Mechanism for regulating electric arc lamps." T. CUTTRISS. Dated June 12.

8884. "Providing improved means of effecting automatically the distance of the carbons in arc lamps, without the aid of clockwork or other like mechanism." W. ROWBOTHAM. Dated June 12.

8901. "Current-regulating devices for use in the circuits of electric lamps, or other apparatus. S. F. WALKER, F. G. OLLIVER. Dated June 12.

8905. "Batteries and accumulators." F. H. VARLEY, W. BEALE, R. H. PADBURY, J. R. SHEARER.

8906. "Apparatus for the regulation of currents employed in telpher and other electric motors." F. JENKIN. Dated June 12.

8907. "Electrical conductors." J. H. JOHNSON. (Communicated by H. Bigeon.) Dated June 12.

8908. "Primary voltaic battery. E. TYER. Dated June 12.

8918. "Automatic telegraph instructor for acquiring the art of telegraphy." C. KAHN. Dated June 13.

8921. "Portable safety electric lamp for miners, divers, and domestic purposes." E. T. BOSTON. Dated June 13.

8962. "Receiving instruments for electric telegraphs." W. P. THOMPSON. (Communicated by S. D. Field.) Dated June 14. *(Complete.)*

8990. "Arrangement of electric telegraph with two Morse relays." W. E. GEDGE. (Communicated by J. Kölzer.) Dated June 14.

8999. "Holders for electric, incandescent, or glow-lamps." J. H. GREENHILL. Dated June 16.

9000. "Electro-deposition of iridium on rollers, doctors, or scrapers used for calico printing, embossing, calendering, or wall paper printing, &c." W. A. CARLYLE. Dated June 16.

9050. "Mechanical telephone." W. P. THOMPSON. (Communicated by A. A. Knudson.) Dated June 17.

9099. "Electrical wires or conductors." H. H. LAKE. (Communicated by J. J. Williamson.) Dated June 17.

9104. "Couplings for metal-cased insulated electric conductors." J. S. RAWORTH, R. A. SMITH. Dated June 17.

9113. "Construction of electrodes. J. S. BEEMAN. Dated June 17.

9115. "Operating electrical switches to ensure positive make and break action of same." H. B. BOURNE, H. R. F. BOURNE. Dated June 17.

9116. "Electrically measuring distances or lengths from a distance." H. B. BOURNE, H. R. F. BOURNE. Dated June 17.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

4788. "Telegraphy." SYDNEY PITT. (Communicated from abroad by P. B. Delany, of America.) Dated October 9. 10d. The object of this invention is to produce a system of duplex telegraphy of the greatest simplicity, which will not be open to the objections which are found to be incident to those systems involving balanced circuits, bridges, &c.

5011. "Electro-plating of rollers." D. APPLETON. Dated October 22. 6d. Relates principally to a former invention, for which Her Majesty's Letters Patent, bearing date the 6th of January in this current year, and numbered 88, have been granted to the inventor. According to the said invention, the inventor made an electro deposit of nickel upon copper printing or embossing rollers, in order to increase the durability of the printing surface, and to lessen the tendency of the colours and matters to act upon such surface. In the electro-plating operation, he has experienced great difficulty in obtaining a firm and uniform deposit, owing to the formation of gas bubbles upon the surface of the roller, and to difficulty in dislodging them. The object of the present invention is to prevent the accumulation of these bubbles upon the roller. To this end the inventor employs a brush which is in contact with the roller during the plating operation, the roller being rotated continuously or intermittently as preferred.

5024. "Printing telegraphs, &c." H. J. ALLISON. (Communicated from abroad by S. D. Field, of America.) Dated October 23. 8d. Relates generally to that class of printing telegraphs in which two type-wheels are used, whose movement is controlled or regulated by an electro-magnetic escapement, so that they are rotated and positioned for printing by "step by step" movement. It relates more particularly to means for determining in such instruments which of the two type wheels shall be printed from; to means for controlling what is now generally termed the "unison" in printing-telegraphs; to means for preventing any

false impression on the record from the wheel not desired to be printed from, and any blurring or disfiguring of the record from accidental contact of the paper with either wheel; to a transmitter adapted for use therewith, and to the arrangement of circuits, both those in the instruments and those connecting the transmitting and printing instruments.

5025. "Checking the visits of watchmen to parts of buildings, &c." J. W. FLETCHER. Dated October 23. 6d. Relates to means and apparatus for checking and recording the visits paid by watchmen or caretakers to various parts of buildings or other places where their presence is required periodically.

5036. "Ignition of inflammable substances and gases by electrical discharge." O. E. WOODHOUSE, F. L. RAWSON, and A. R. MOLISON. Dated October 23. 6d. Relates to the adaptation, by improved adjuncts, of the hermetically-closed self-inductive electrical machine (patented to the said Alexander Reid Molison under date March twelfth eighteen hundred and eighty-three, and numbered 1295) or of modifications thereof, and to the ignition of inflammable substances such as powder, or of gasses, such as coal gas or spirit, by electrical discharge.

5042. "Electrical igniting apparatus for gas engines." W. R. LAKE. (Communicated from abroad by N. de Kabath, of Paris.) Dated October 23. 6d. Relates to apparatus for igniting instantaneously and with safety, by means of an electric spark, explosive mixtures employed for the production of motive power in gas engines. This apparatus is constructed upon the following principle, viz., a part of the motor is arranged to act by means of suitable gearing upon the armature of a permanent magnet or an electro-magnet, the pole or poles of the permanent magnet, if such is used, being surrounded by a coil or coils of conducting wire. The two ends of the wire of the coils are connected with two metallic pieces or rods placed in line with each other, a suitable interpolar space being left between the same. At any desired time the part of the motor above referred to suddenly separates the armature from the magnet, and causes the formation of an induced current in the coils of the magnet, which current produces a spark in the interpolar space between the two metallic pieces or rods. This spark effects the ignition and explosion of the gaseous mixture, which, in its turn, acts, by reason of its elastic force and expansion, upon the motor piston.

5043. "Electrical accumulators." W. P. THOMPSON. (A communication from K. W. Zenger, of Austria.) Dated October 23. 2d. Has for its object an improved accumulator, the characteristic feature of which consists in positive pole-plates (or cathodes) surrounded by some halogen, such as chlorine, bromine, or iodine, these halogens having a depolarising action, and combining themselves, as soon as both poles are connected, by means of a conductor, with the hydrogen surrounding the negative pole-plate (*i.e.* anode). (*Provisional only.*)

5065. "Transmitting electric energy to tram or railway cars." M. H. SMITH. Dated October 24. 1s. 2d. This invention relates to improved apparatus for conducting and for collecting the electricity for supplying the motor or electric engine of railway or tramcars being further additions to or improvements in apparatus described in the specification of Letters Patent granted to the inventor dated February 24, 1883, No. 1014. According to this invention, the inventor places within the channel described in the above-recited specification, but insulated therefrom, a metal tube having a slit or opening running throughout its length, and within the tube is placed a collector or shuttle composed of two heads or points, connected by spiral or other springs, and a spindle passing within the springs and hollows formed in the heads or points. The shuttle is operated by a plate or plates passing through the slit in the tube, and the parts are so arranged that when the shuttle is moved in either direction, the friction against the inside of the tube tends to expand the spring or springs, thus insuring electric contact. The electricity can be conveyed to the tram car or engine, and the shuttle made to travel with it, by slight modification of any of the various methods described in patent 1014[83]. In another construction metal plates are placed upon either side of the channel, but insulated therefrom; these plates may be plain or flanged, and between them runs a collector trolley—alternate wheels on this trolley press upon or against the right or left hand plates—the axis of the wheels may be vertical or slightly depart therefrom, to ensure frictional contact, and contact is further ensured by means of a wire or tape so threaded between the brushes or bearings of the wheels, that when drawn by means of a screw and spiral, or other spring, the wheels are forced outwards and against the conducting plates. Or the framework supporting the wheels may consist of a series of knuckle joints, so arranged that when the trolly is pushed forward the wheels are forced outward and into contact with the electric conductor or conductors.

5069. "Secondary batteries." J. S. SELLON. Dated October 24. 6d. Has partly for its object to overcome the leakage of electricity occasioned in some forms of secondary batteries by the spreading or aggregation of moisture from various causes such as through capillary attraction round or over the edges of the plates or by the condensation of atmospheric moisture, or by the splashing which may occur in charging, and also has reference to modifications in the form of the upper parts or edges of the plates in order to arrest the spray which may be given off during formation or whilst charging in the ordinary way, and further to give a convenient form for packing in stacks or columns with ready access to the electrolyte which may at the same time obviate the capillary attraction or the effect of the splashing or spilling. According to the said invention, for instance with such forms as annular basin or pyramid shaped or other plates, the edges of which can be so treated, the inventor makes grooves, corrugations, or overlappings of suitable form either at or around the extreme edge or conveniently near thereto, or he casts upon, affixes to, or works up with, the plates, projections, or ridges or bent portions which may serve an equivalent purpose, and into the space or cavity of or formed by such grooves, projections, or spaces, he places any suitable insulating material or compound of a nature suited to arrest or entirely stop the capillary attraction or extension of the moisture which might otherwise form a junction with the moisture on the adjoining plate. Such material as paraffin or a mixture of paraffin with asbestos is very suitable for the purpose of the invention.

5072. "Insulators for electrical purposes." E. ROE. Dated October 25. 4d. Consists in the construction of insulators of metal (by preference cast iron) coated with any suitable liquid vitreous material or substance fused into the surface of the metal.

5078. "Electro-motors and dynamo machines." W. R. LAKE. (Communicated from abroad by H. Walter, of America.) Dated October 25. 2d. The inventor provides two rotatory wheels mounted upon an axis, in combination with two series of fixed electro magnets arranged in circles upon stationary discs or plates placed near the said wheels and parallel thereto. (*Provisional only.*)

5081. "Switch apparatus for connecting and disconnecting electrical lines for telegraphic or telephonic communication." J. IMRAY. (Communicated from abroad by T. A. Connolly, of America.) Dated October 25. 6d. Relates to switch apparatus for effecting connection and disconnection of electric lines or conductors employed for telegraphic or telephonic communication, so that in cases where a number of such lines radiate from a central station or exchange, any one of these radiating lines can readily be put in connection with any other. (*Provisional only.*)

5082. "Dynamo-electric or electro-dynamic machines." R. E. DUNSTON, A. PFANNKUCHE, and J. FAIRLIE. Dated October 25. 4d. relates to a cheap and simple construction of the iron core of the annular revolving armature employed in many dynamo-electric or electro-dynamic machines, in such a manner as to render it more effective than these cores as they are usually constructed, and to avoid the overheating of the armature and machine when in work. For this purpose, the inventors wind on a cylindrical mould a number of convolutions of a soft iron hoop along with a tape or strip of insulating material such as textile fabric, caoutchouc, gutta percha, or the like, so as to separate each convolution of the hoop from the next. When sufficient length of hoop and tape has been wound on to make up the annulus to the required thickness, they secure the ends and remove the annulus from the mould, to be wound round with insulated wire and mounted in the machine in the usual way. The tape or strip of insulating material should be a little broader than the hoop, so as to present an edge beyond each side of the hoop for more effectually separating each convolution from the next.

5103. "Electric gas-lighters." T. TAYLOR and J. TAYLOR. Dated October 27. 6d. Relates to that class of gas-lighters wherein an electric spark is employed for lighting the gas issuing from a burner or jet, the object of the invention being to direct the gas exactly on to the point where the spark is produced, and thus insure the immediate lighting of the gas by one single spark only, as well as to prevent the waste and escape of gas. By these means electric gas-lighters are enabled to be used for a much longer time without the necessity for renewing the galvanic battery than they can be as ordinarily constructed, as it usually requires several sparks to be emitted before the gas is lighted. For this purpose the inventors attach to the tube which carries the terminal wires a hanging funnel or cone, so formed, and hung, that any gas entering the base or mouth of the funnel is directed through the opening at the apex thereof exactly on to the point between the two terminal wires where the spark is formed.

5108. "Cut-out for telephones." A. M. CLARK. (Communicated from abroad by O. B. Carter, J. T. Fouche, C. A. Fisher, and C. D. Wright, all of America.) Dated October 27. 2d. The object of this invention is to provide a new and improved device for cutting out all the resistances and telephones on a line between the two telephones which are to be in communication. (*Provisional only.*)

5109. "Generation, storage, regulation, distribution, &c., of electricity." J. S. WILLIAMS. Dated October 27. 5s. 2d. Consists in improvements in and relating to the generation, storage, distribution, regulation, measurement, and utilisation of electricity and apparatus, or means therefor, and in methods or means to be employed in the construction of such apparatus or parts thereof. (This specification consists of 124 pages.)

5111. "Magnetic garments." G. CARRON. Dated October 29. 2d. Has for its object improvements in magnetic garments or clothing for the prevention, relief, and cure of disease or other complaints of the human body, also applicable to the bodies of animals, such as horses, dogs, cows, and other animals, by which the inventor is enabled to convey stronger currents with a given weight of metal, as well as to make the garments more elastic with a given weight than has hitherto been attainable, and further by so arranging the magnets in such garments or clothing as to obtain a continuous current or currents through the garment or garments. (*Provisional only.*)

5127. "Electrical generators and motors." T. J. HANDFORD. (Communicated from abroad by T. A Edison, of America). Dated October 29. 6d. Relates to the construction of dynamo-electric machines and electro-dynamic motors having continuously-wound bobbins connected at intervals to commutator bars, whereby the sparking at the commutator will be greatly reduced or wholly obviated, overcoming the necessity for changing the current collectors upon the commutator in accordance with variations in the load upon the machines when used either as generators or motors, increasing the capacity of the machines, and decreasing the heat generated in the armature coils, and also diminishing the wear of the commutators and the collectors.

5132. "Dynamo-electric machines." S. Z. DE FERRANTI. Dated October 29. 6d. The inventor winds the wire upon the field magnets in planes parallel to the axis of the armature or wheel, thus the wire may pass first along the field magnet over the upper side of the armature, then down past the end of the armature, returning again underneath the armature, and so on, the winding being always parallel to the axis, and in large convolutions completely encircling the armature. At the two ends the winding will deviate from the direct course in order to admit of the passage of the axis, and, if necessary, also to allow the wheel or armature to be readily inserted and withdrawn. In place of arranging the winding entirely in a vertical plane some of the winding may be horizontal, and other portions of it may lie in planes variously inclined to the vertical, but always parallel to the axis of the armature, which is assumed to be horizontal.

5141. "Telephones." W. GILLETT. Dated October 30. 6d. The inventor employs a series of independent telephonic transmitting devices operated by one and the same action of the voice, and all contributing to the effect produced at the other end of the line. He mounts a series of pairs of electrodes near each other, and in contact with a rigid piece receiving motion from a diaphragm. The rigid piece may be a concave disc, firmly fixed by its centre to the centre of the ordinary vibrating diaphragm. It communicates the motion of that point to a series of pins, which, delicately mounted and adjusted, each serves as one of the electrodes. He insulates the arms on which these are mounted, and makes independent connections from each arm to its proper induction coil.

5151. "Transmission of intelligible signals by electricity." G. A. CASSAGNES. Dated October 30. 10d. The object of the invention is to combine the multiplex system of telegraphy with the stenographic processes, that is to say, to transmit by electricity, to a distant station, stenographic signs, and to print or reproduce them, by and with a stenographic process, and machine or machines connected with generators and conductors of electricity.

CORRESPONDENCE.

Silvering Incandescent Lamp Bulbs.

Referring to the query contained in your issue of the 24th May last, as to the silvering of incandescence lamp globes, and to the communications on that subject published in your issues of the 31st May and 14th June, we are requested to inform you that that process has been protected by two patents, which are now jointly owned by the two inventors, and that in the event of infringement of the patents they will, of course, feel compelled to take the necessary steps in vindication of their rights.

Burton, Yeates, Hart & Burton.

37, Lincoln's Inn Fields, London, W.C.
17*th June*, 1884.

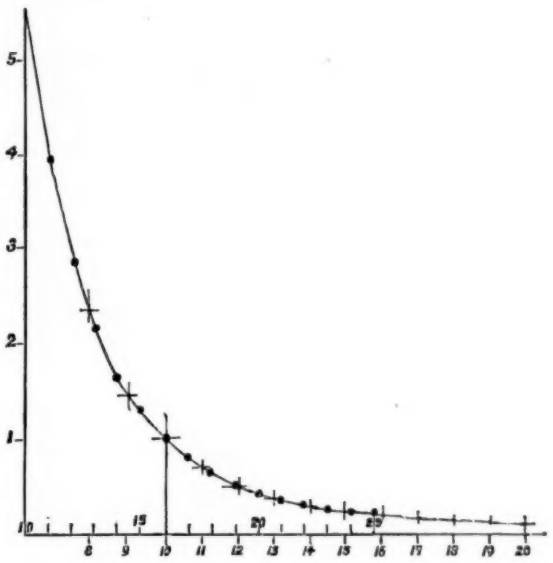
[We do not know to what patents our correspondents refer; it would have added some weight to their statement if the names of the inventors, or the numbers and dates of the patents had been given.—EDS. ELEC. REV.]

On the Connection between Strength of Light and Duration in Glow Lamps.

On page 484 of your impression of the 7th instant you give some figures which have a suspicious look about them, and I have taken the trouble to examine them closely.

In the first place it seems odd that 10 and 16-candle lamps should, when kept at their respective normal powers during "prolonged experiments," each last *exactly* 1,000 hours—the life which is generally claimed for them; but, if you look at the hyperbolic curve I now enclose, you will notice some stranger agreements still!

Taking one quarter of an inch per candle for the horizontal scale, and 1,000 hours per inch for the vertical scale, I plot out the particulars of the 16-candle lamp (at all powers except 30 candles), and so I obtain the curve shown in full line. The wonderful regularity of this curve says a good deal for "prolonged experiments," but it is not until we lay off another horizontal scale (centimetres instead of quarter inches) on both sides of the point common to the 10 and 16-candle lamps, that we realize how carefully these "experiments" have been carried out; for not only does the curve already found give us the correct "duration" of the 10-candle lamp when burning at all powers between 8 and 15 candles, but, if we use the new horizontal scale for the next five powers of this lamp up to 20 candles, and then set off the "duration," given by the German writer, we get the proper continuation of the curve!



All this is not due to mere accident, and I think that unless our friend with the Biblical name has been imposed upon he has done one of two things—either he has taken a hyperbolic curve and used the very horizontal scales I mention, or he has calculated the "durations" from the equation to the curve I have sent to you; and, in any case, I do not attach any value to his "prolonged experiments."

Wm. H. Massey.

Twyford, Berks.
16*th June*, 1884.

Induced Continuous Currents.

With reference to Mr. de Wolffers' article in your last issue, will you permit me to call that gentleman's attention to my specification, No. 2434, 1883?

The apparatus (fig. 2) in the article in question is substantially covered by the claims in my specification.

I have recently been writing in the REVIEW on one form of application of my invention. The other mode of application—viz., with continuous currents acting on an electro motor or a combination of concentric magnets by means of movable commutators or brushes—I have not yet been in a position to verify with sufficient confidence to commit the results to print; otherwise I should have forestalled Mr. de Wolffers.

E. L. Voice.

1, Francis Street, W.C.,
June 13*th*, 1884.

Continuous Current-Induction Apparatus.

The proposition of M. F. de Wolffers for the construction of a continuous current-induction apparatus, which was explained at length and illustrated in yours of June 14th, is in all respects similar to a proposition

which occurred to me early in 1879, and in August or September of that year, I wrote to Mr. J. T. Sprague, of Birmingham, on this very subject, and enclosed a sketch of the apparatus with a view to have his opinion, and, judging from that gentleman's writings on electrical matters, I considered his opinion as of some value, he showed me that the whole argument in support of the proposition was erroneous.

I constructed the apparatus, using a ring armature wound with two circuits of wire, each circuit having a separate commutator around which two brushes could be rotated. On trying this machine, exciting one circuit with a current of seven ampères, and rotating the brushes at two thousand revolutions per minute, the only currents induced in the other circuit was a very feeble intermittent current scarcely measureable, and which currents I was certain did not owe their origin to the magnetic poles jumping round the ring armature. So much for experimental evidence; but I am sure most of your readers who carefully read M. de Wolffer's explanations would perceive the fallacy of the proposal, in fact it is an attempt at perpetual motion, because, if the mere rotation of magnetic poles on a ring can induce electric currents in a wire wound on the ring, then it is only necessary to start the action by a slight current sent into the inducing or primary circuit while rotating the brushes, and then cause the induced or secondary current to flow through the primary circuit, and thus get all the actions and re-actions which we obtain in a dynamo by sending its induced current round the field circuit, and that too by merely whirling round two pair of brushes, and we only want an armature, no field magnets, no belts, no steam engine; a clock would drive the brushes round.

And the same reasoning applies to the form of apparatus (fig. 2) in M. de Wolffer's proposition, if the rotation of the poles on the outer ring can induce currents in the wire of the inner ring, then why not take the outer ring as we take the field magnet of a dynamo and excite it by the current induced in the inner ring after starting the action by a magnet or otherwise? My answer to this question is, because the rotation of magnetic poles on an iron ring cannot possibly generate currents. Only by *rotating the ring* carrying the poles can we get induced currents.

Although M. de Wolffer's proposition is not capable of being put into practice, yet a profound study of his reasoning, and of the proposed machines, will well repay even the highest authorities on dynamo machine construction. This proposition shows very forcibly to what conclusions the very little understood theories of dynamos can be followed.

I could enumerate a few other cases in which (according to the absurd theories promulgated by writers of text books, and lecturers on dynamos, on the induction of currents) powerful currents ought to be generated, and yet no effect is obtained. In fact all the theories hitherto expounded to account for the generation of currents in ring and drum armatures lead to the most absurd conclusions if logically followed up.

Rankin Kennedy.

Glasgow, *June 16th*, 1884.

British Spiral Wire Syndicate.

A few months since you made some rather severe remarks on this company, and we, the public, were promised some satisfactory tests that would triumphantly refute your assertions. Have such tests been made, and with what results? If not, why not? That question, however, is not the object of this letter, and I write to ask you if you or any one of your readers can account for a circumstance which appears to me wrapped in mystery. In the prospectus of this company, claiming "unlimited distance for both telephone and telegraph service, underground, aerial, and submarine," it is stated, "The inventor decided that the core must be made *dense* and *hard*, so that every molecule comprising that core should be effected from end to end of the wire in active agitation, while the spiral surfaces should be soft and absorbing for comparative slow conveyance of all retarding and outside inductive influences." Now, to carry out this theory it is evident that "the dense and hard core" must be continuous from end to end, otherwise it seems to me to be utterly useless. The working of the wire in America by the American Spiral Telephone Wire Company, of Boston, Mass., to my idea perfectly upsets this same theory *in toto*, for, instead of splicing the *core* where joining is necessary, they merely hitch the ends together and twist them up in the usual way, thus not only severing the continuity of the core, but actually inserting between the ends thereof "the soft and absorbing metal for comparative slow conveyance." I may be in error, but the above seems to me to prove either that the theory is wrong or that the company does not carry it out.

Can any electrician more learned than myself on the subject enlighten me as to the above?

Enquirer.

P.S.—How are the wires joined at Dundee, where the trial was made by Mr. Bennett?

[We are not aware that any further tests have been made with the "spiral wire," although it is almost time that something fresh should transpire in this matter.—EDS. ELEC. REV.]

Automatic Reversing Commutators.

In your issue of the 5th of April there is a description, with drawings, of an automatic reversing commutator, which is there stated to have been devised by Mr. Volk, of Brighton. It enables a dynamo driven from a railway carriage axle to charge accumulators independently of the direction of motion of the train, and causes the dynamo to be disconnected from the accumulators when the train is going in either direction at lower than a certain speed, as well as increasing the lead of the brushes as the speed of the dynamo becomes higher. Permit us to mention that this invention was patented by us in our specification, No. 4532, of 1882, and forms claim No. 4 in that specification.

The confusion has probably arisen from our having sent, in the summer of 1883, working drawings of an Ayrton and Perry dynamo with this apparatus attached, to Mr. Volk to be constructed for us. During the construction, Mr. Volk suggested certain changes in the details of the centrifugal governor, but made no change whatever in the essential principles of the automatic reversing commutator, and it will be seen that figs. 12 and 13 of our patent specification differ only in the mechanical construction of the governor from the drawing given by you in your issue of April 5th. The special mode of fixing the commutator pieces so as to secure high insulation with small loss of power from friction, shown in the same drawing of Volk's automatic reversing gear, is not only the one shown in the drawings accompanying our patent specification above referred to, but was originally claimed in claim No. 5 of our specification, No. 1178, of 1880, a patent which was continued in 1883.

The terms of the contract for the construction of the dynamo not having been complied with as to the time of delivery, we expressed our dissatisfaction, and Mr. Volk said he was willing to keep the uncompleted machine for his own use.

It is quite possible that Mr. Volk is using our automatic reversing gear for some other dynamo than that for which it was designed, seeing that the dynamo in question is now, we understand, being employed to drive the Brighton electric tramcar; but that, of course, gives Mr. Volk no claim to the design.

We should not have troubled you with this matter, but that we wrote some time ago to Mr. Volk on the subject, but he declines to make the explanation we have just given.

W. E. Ayrton.
John Perry.

Telpher House, 73, Great Eastern Street,
London, 16*th June*, 1884.